
Chapter 5

Late Pleistocene Foragers, *c.* 35,000–11,500 Years Ago

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Introduction [HB, GB]

The boundary between this chapter and the previous one is set by the sudden mudflow of wet guano and its rapid reworking, Lithofacies 3 and 3R (the ‘Pink and white silts’ defined in Chapter 3), which engulfed much of the archaeological zone of the West Mouth, partially covering the interbedded Lithofacies 2 and 2C and the human-occupation record contained within them, including the Deep Skull. The most important lithofacies for determining the history of this period of time is Lithofacies 4, the ‘Brown silts with anthropogenic deposits’ immediately overlying Lithofacies 3 and 3R. The oldest radiocarbon dates from Lithofacies 4 are from charcoal in the Harrison Excavation Archive, originally obtained at 60–66 inches depth in Trench Y/E3, of 35,890±250 bp or 40,489–41,613 BP (OxA-15163), and from charcoal we obtained from the pit-infill deposits overlying Lithofacies 3 in Section 2.1 (Fig. 3.29), of 33,790±330 bp or 37,431–39,550 BP (OxA-11302) and 29,070±220 bp or 33,121–34,518 BP (OxA-11303). The boundary between this chapter and the next is the global transition to the Holocene, the modern climatic era, now dated in Greenland ice cores to 11,702 calendar years before the year 2000 (Rasmussen *et al.* 2006) but for convenience here rounded to *c.* 11,500 BP. Lithofacies 4 continued to accumulate into the Early Holocene (Chapter 3).

In terms of the global climatic record established from palaeotemperature studies of ocean floor sediment cores and from polar ice cores, the chapter includes the latter part of Marine Isotope Stage (MIS) 3, which is dated to 59,000–29,000 BP, and the whole of MIS 2 (29,000–11,500 BP). The period was characterized overall by the rapid cooling of global air temperatures, culminating in the Last Glacial Maximum (LGM). This is identified broadly in the lowland region of Sundaland as dating from *c.* 23,000–16,300 bp or

c. 27,000–19,500 BP and it is in this sense that the term LGM is used in this chapter (see Hastenrath 2009 **NOT IN REFS**, 709; Wang *et al.* 2009). The LGM was probably the most extreme climatic episode of cold and aridity at a global scale that our species has ever experienced, followed by sustained global warming. Within this broad picture, one of the most important developments in palaeoclimatic studies in recent decades has been the recognition of the instability of Late Pleistocene climates and the abrupt nature of climatic shifts, with millennial-, centennial and even shorter-scale shifts being discerned in the North Atlantic MIS 2 records (e.g. Blockley *et al.* 2006; Clark *et al.* 2002; Taylor *et al.* 1993; Fig. 5.1). In the northern hemisphere, there was a major shift to warmer and wetter conditions following the LGM termed the Bølling-Allerød interstadial (*c.* 14,700–12,800 BP), which was punctuated by at least two significant cold episodes, followed by a return to cold and dry near-glacial conditions, the Younger Dryas (*c.* 12,800–11,700 BP) before the shift to warmer climates that marked the Holocene. In the southern hemisphere, isotope studies of ice cores in Antarctica suggest a more continuous pattern of uninterrupted deglaciation and warming.

It used to be thought that environmental change in the tropical lowlands of Southeast Asia during the Late Pleistocene must have been far less extreme than in northern latitudes, but it is now clear that many profound changes also took place in this region (Flenley 1997; Kershaw *et al.* 2007). The human populations of northern Borneo certainly had to cope with dramatic changes in the geography and ecology of the landscapes they inhabited in the Late Pleistocene, though as discussed in the next section their precise characteristics in the Niah region remain uncertain. Much important evidence about the climate, geography, and habitats of the region through this period derives from locations far distant from Niah. Within

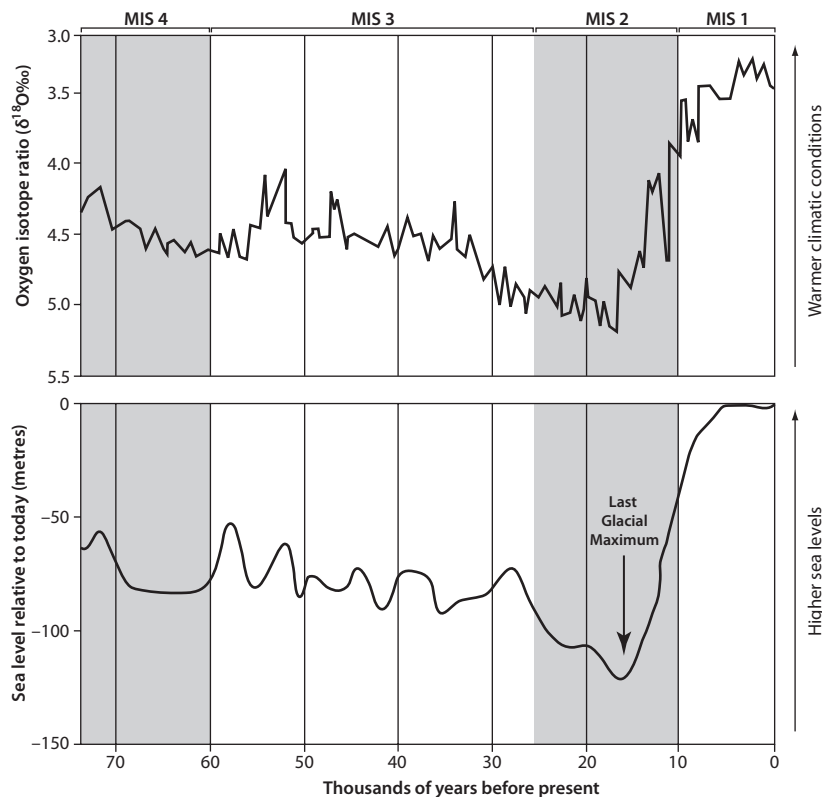


Figure 5.1. The instability of Late Pleistocene climates: (above) the global temperature curve in Marine Isotope Stages (MIS) 4–1 inferred from high-resolution Greenland ice cores, and (below) the global sea-level curve. (Illustration: Dora Kemp; after Hiscock 2008, fig. 2.1.)

the West Mouth there is evidence for sediment reworking and for significant stratigraphic breaks within the sequence, interpretation being all the more difficult because most of Lithofacies 4 was removed in the original excavations (Fig. 3.30). Nevertheless, the archaeological record from Niah indicates that the responses of people to the profound changes in environments and habitats of the Late Pleistocene included new modes of living in the landscape, supported by new extractive technologies.

Late Pleistocene climates and environments

[DG, CH, HB, LK]

Reconstructions of the region's ancient landscapes typically stem from two different types of analysis (e.g. Adams & Faure 1997 **NOT IN REFS**; Kershaw *et al.* 2007; Pickett *et al.* 2004; Sun *et al.* 2000; Wang *et al.* 2007; 2009). The first of these derives directly from empirical evidence: palaeontological, geomorphic or geochemical. The second group consists of simulations, in particular of past coast-lines (Sathimurthy & Voris 2006; Voris 2006 **NOT IN REFS**) and potential past vegetation (Bird *et al.* 2006; Cannon *et al.* 2009). The advantages of such simulations are that they offer substantial spatial resolution and are at a continental scale. With few exceptions (e.g. Bird *et al.* 2007), however, they have not as yet been modified

to incorporate information on local factors that may have been of considerable importance such as the details of the buried coastal topography, the changing nature and intensities of past human activity, or edaphic factors such as the deep podsoils on ancient sandy coastal landforms that could have promoted *kerangas* forest-types (Brunig 1974). In general most work in either category of study has focused primarily on the LGM, which comprised only *c.* 30 per cent of the period covered by this chapter. Comparatively little is known about the previous eight to nine thousand years, especially for terrestrial sites, less so for offshore locations in the South China Sea.

Regional climates

Previous palaeoecological research has often focused on reconstructing past variations in air temperatures and in precipitation regimes during or close to the LGM. Kershaw and colleagues (2007), for example, estimated that average annual temperatures rose by *c.* 1–1.5°C between *c.* 30,000 to *c.* 26,000 bp (*c.* 34,000–30,000 BP) and then fell dramatically, and aridity increased markedly, until the peak of cool and dry conditions at *c.* 20,000–18,000 bp (*c.* 24,000–21,000 BP). They suggested that the fall in average annual temperature could have been as much as 7–11°C when compared with today. Their estimates contrast with the continental-scale biogeographical analysis of



Figure 5.2. Sundaland, showing the changing position of the coastline between c. 40,000 and 12,000 years ago, and the principal places mentioned in the chapter.

Pickett *et al.* (2004), which suggested an LGM cooling (in comparison with present-day values) of only 1–2°C at the contemporary sea level compared with 6–9°C at high-altitude sites.

Isotopic studies of microscopic marine organisms (planktonic foraminifera) from the South China Sea indicate surface water temperatures in the order of 2–3.5°C cooler in the LGM than today (Lea *et al.* 2000; Rosenthal *et al.* 2003; Stott *et al.* 2002; Visser *et al.* 2003). Substantial fluctuations in the palynological data from seabed cores from the South China Sea

suggest significant further short-term fluctuations in temperature and vegetation cover within the LGM (Wang *et al.* 2009).

The enormously enlarged land mass of Sundaland (some 75 per cent larger than exists today) caused by sea-level lowering, most notably during the LGM (Fig. 5.2), is predicted to have affected the positioning of the atmospheric Inter-Tropical Convergence Zone, resulting in lower annual precipitation and more pronounced dry seasons over northern Borneo (Kershaw *et al.* 2001). Rainfall is also estimated on this

basis to have been reduced by 30–50 per cent in some parts of the Sunda Shelf, although a strengthened winter monsoon could have led to locally increased rainfall along parts of the exposed Sunda shelf north of Borneo (Bird *et al.* 2005, 150). Isotopic studies of speleothems from the Mulu Caves inland of Niah, however, indicate that significantly drier climatic conditions began there *c.* 20,000–18,000 BP, with further drying *c.* 16,500 BP; wetter climates only returned from *c.* 15,500 BP (Partin *et al.* 2007). The summer monsoon probably returned in a punctuated rather than gradual manner from around 13,000 BP (Hope *et al.* 2004 **NOT IN REFS**). With the exception of those cores investigated by Kienast and colleagues (2001), other ocean-floor sites in the northwest Pacific and south of the Equator, like the speleothems at Mulu, have not indicated any local equivalent of the Younger Dryas cold period of the northern hemisphere (Lea *et al.* 2000; Partin *et al.* 2007; Rosenthal *et al.* 2003; Stott *et al.* 2002), though the El Niño oceanographic/meteorological events that characterize the modern region are recognizable in the Early Holocene estuarine molluscan faunas found in Lithofacies 4 (Stephens *et al.* 2008; see Chapter 6) and such events may have been present earlier.

Regional landscapes

The best-known reconstructions of coastal physiography are the spatially ‘coarse-grained’ interpretations of Voris (2000) based on hydrographic charts and, more recently, refinements using high-resolution satellite-based topographic data (Sathiamurthy & Voris 2006; Fig. 5.2). Throughout all but the youngest period covered by this chapter, ocean levels would have been below the 40 m lowering necessary to link Borneo to the islands of Java, and Sumatra, and to the peninsular mainland of Southeast Asia. In the earlier part of the period covered by this chapter, until *c.* 30,000 BP, ocean levels fluctuated at depths of *c.* 60–90 m below the present levels. The start of rapid fall to the LGM low of 120+ m was *c.* 30,000–28,000 BP.

The distance across the flattest central parts of central Sundaland from the modern shoreline to the South China Sea’s shoreline during the broadly-defined LGM was over 900 km (Jian *et al.* 1998). This greatest expanse of lowland Sundaland lasted for five to six thousand years. In these parts, between the end of the LGM and the beginning of the Holocene, the average lateral rate of transgression over much of coastal lowland Sundaland was about 50 m per year, and a remarkable 0.3–1 m per day at its fastest (Jian *et al.* 1998). The rate of transgression must have been significantly slower across the lowlands to the north of the Niah Caves because the continental shelf there is much narrower and at least 2–3 times steeper than to the west.

Geophysical and coring evidence from the bed of the modern South China Sea shows that the rate of marine transgression altered over time. During Meltwater Pulse 1A, synchronous with the beginning of the Bølling/Allerød interstadial in northern latitudes, the sea rose rapidly by at least 16 m, or *c.* 5.3 m per 100 years (Hanebuth & Stattegger 2003b **NOT IN REFS**; Hanebuth *et al.* 2000), and possibly by as much as 25 m in that period (Lambeck *et al.* 2002 **NOT IN REFS**). Thereafter, between *c.* 14,300 BP and *c.* 13,100 BP, it slowed to *c.* 1.3 m per 100 years. Borneo was separated by the sea from peninsular Malaysia by *c.* 12,000 BP, and from the present islands of Java and Sumatra by *c.* 10,000 BP (Bird *et al.* 2005). Such high rates of marine transgression and the associated consequences, such as the progressive ponding of rivers and the saline contamination of coastal ground-waters, is likely to have had significant effects on the coastal ecology of Sundaland, for both flooding and regression, but the ecological consequences would have been very different.

Viewed in timeframes of centuries or decades, these extraordinary transformations of the topographic and biological landscapes appear likely to have had important consequences for foragers living along or near the coast, perhaps characterized by episodic widespread redistributions of population both inland and toward more stable ecological zones behind the advancing coastlines after the LGM. This scenario finds support in studies of present-day regional population genetics (Soares *et al.* 2008). They indicate that there were three major expansions of population in the Late Pleistocene and Early Holocene across what is now Island Southeast Asia, the first of which took place around 14,000 BP, which is approximately the period when the rates of sea-level rise/marine transgression were at their most rapid (Fig. 5.3).

Those areas with the most unstable coastlines would have been characterized by varied and unpredictable changes in resource distribution. They may not have represented good environments for human foragers until rates of water transgression slowed, and may not have been intensively utilized until after sea levels stabilized in the Early to Mid Holocene (Sathiamurthy & Voris 2006; Stienke **Steinke??** *et al.* 2003 **NOT IN REFS**; Terrell 2002 **NOT IN REFS**). In the period between *c.* 40,000 BP and the LGM, initial small-scale oscillations in ocean level and then the sustained rapid fall would have extended the opportunities for people and wildlife to settle within or move across the wide coastal lowlands created (Pope & Terrell 2008 **NOT IN REFS**).

The marked rise in temperature that characterized the period **< before??** *c.* 35,000–30,000 BP was **characterized USE ANOTHER WORD** by a sig-

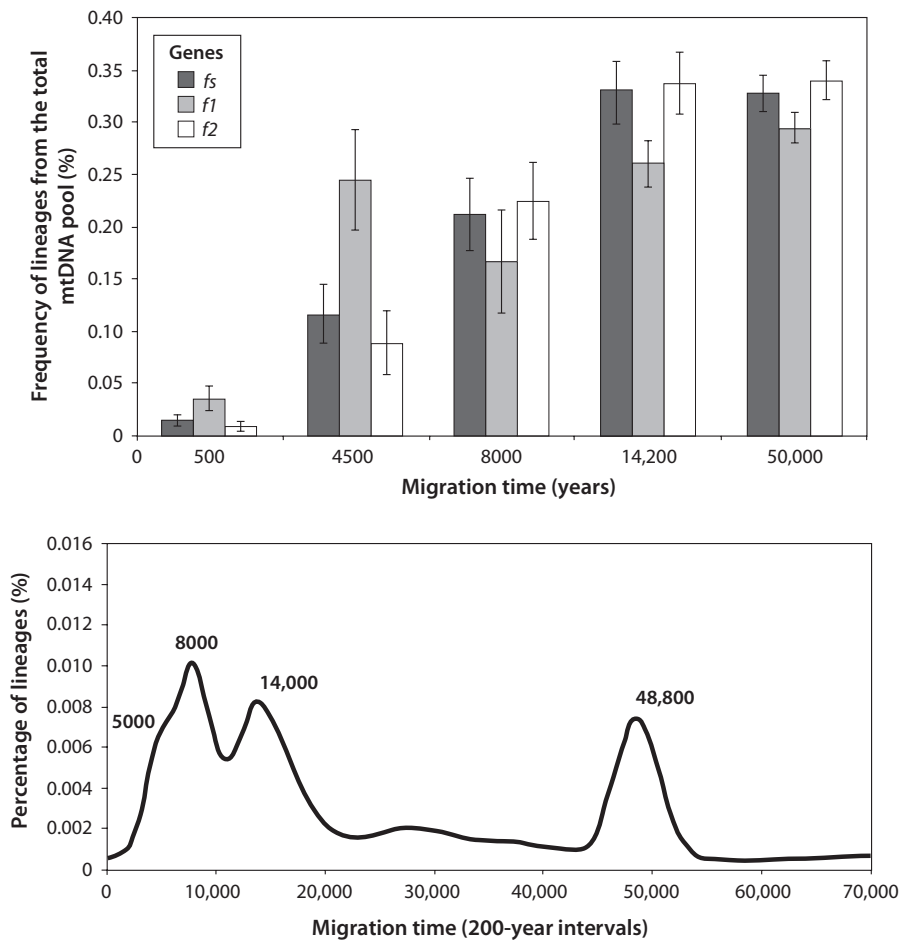


Figure 5.3. The chronology of early human dispersals reconstructed from the analysis of mitochondrial DNA in present-day populations of Island Southeast Asia. (After Soares et al. 2008.)

nificant increase in the altitude of upper montane forest (Kershaw *et al.* 2007). Initially found in the region at c. 2300 m above sea level (in contrast to c. 3700 m today), montane forests were at c. 2700 m by c. 30,000 BP. This was followed in Borneo, during the broadly-defined LGM, by a marked lowering in the elevations of forest limits, together with all the other vegetation zones, whilst steppic vegetation developed across wide areas to the north and west of the South China Sea. There were significant spreads of herbaceous vegetation and temperate broad-leaved forest to the north and the west, and substantial pine forests in uplands further inland to the north.

Around the shores and inlets of the (then) South China Sea, mangroves grew in sheltered inter-tidal areas and in some major river mouths such as the Molengraaff (Hanebuth & Statterger 2003b NOT IN REFS; Zheng & Li 2000). These bands of mangroves were sometimes behind barrier beaches and sand dunes, with mangrove habitats adjusting to local

shifts in the position of the coastline. Marsh vegetation was established in estuaries of major rivers such as the Molengraaff. Lowland river basins included swathes of sedges, reeds and bamboo, a variety of ferns including tree ferns (*Cyrtosperma*), and palms around marshes. There were swamp forest and spreads of *Pandanus* on floodplains and in shallow topographic basins. Riparian forests and swamp-forests were present on marshy soils, in in-filled basins, on much of the riverine alluvium, and numerous sandy soils re-worked from older Pleistocene coastal landforms (Wang *et al.* 2009).

There was a much greater spread and richer variety of forest types to the south, including on the modern island of Borneo and its exposed continental shelf, than further north. On the lowlands of Sundaland there were probably large tracts of tropical lowland rainforest, swamp, and riverine forests, together with east/west-aligned *kerangas* forest on former Pleistocene beach and dune ridges, and lagoons and marshes of

various dimensions. Quantitative simulations by Cannon and colleagues (2009) of potential vegetation at the LGM have predicted a complex vegetation type ('transitional hill forest') on the lowlands of northern Borneo, though the palynological and phytolith data from the West Mouth described in the next section indicate drier and more open landscapes.

There were substantial glaciers on the highest mountains of Borneo (Mount Kinabalu) during the LGM, as well as in southern Indonesia and New Guinea (Hastenrath 2009 **NOT IN REFS**; Peterson *et al.* 2002 **NOT IN REFS**; Wang *et al.* 2009). Glaciers persisted on Mount Kinabalu until *c.* 9200 BP (Flenley & Morley 1978 **NOT IN REFS**). Snow lines were depressed by as much as 1000 m as typical upland temperatures fell by 6–10°C, and the upper altitudinal limits of forest during the LGM may have been *c.* 1000–1300 m lower than today (Kershaw *et al.* 2007). 'Cool' sub-montane taxa and ferns dominated the vegetation at Lake Sentarum on the lowlands of western Borneo at *c.* 29,000 BP (Anshari *et al.* 2004). The vegetation that nowadays characterizes the highest mountains and alpine habitats of Borneo has not been detected at Niah, although the bones of the Borneo ferret-badger (*Melogale everetti*), a taxon now restricted to Mount Kinabalu, reported by Medway (1966a) from the West Mouth vertebrate fauna, appear to be in this category. The co-occurrence of significant quantities of pollen of both montane forest and lowland rainforest at Lake Sentarum around the LGM was thought to indicate a forest type without modern analogues, but it is also notable that, despite the widespread evidence for greater dryness here during the LGM, the land surface remained sufficiently wet for peat to accumulate (Anshari *et al.* 2001).

The cool and moist conditions of the LGM enabled a montane fauna to descend to lowland habitats on the Bird's Head peninsula of Papua (Aplin *et al.* 1999). The exposed continental shelf of 'Sahul', between New Guinea and Australia, was covered in grass and shrub-rich vegetation, presumably in a comparatively dry environment (Chivas *et al.* 2001; van der Kaars 1991; Kershaw *et al.* 1993 **NOT IN REFS**; Wang *et al.* 2009). The palaeoenvironmental evidence from within and immediately outside Liang Bua cave on the island of Flores indicates rapid, climate-driven, fluctuations of vegetation type, including a wetter episode at *c.* 18,000 BP that caused the temporary expansion of rainforest (Westaway *et al.* 2009). With warming air temperatures and the return of the summer monsoon in the closing millennia of the Pleistocene, lowland rainforest expanded widely across Sundaland (Hope *et al.* 2004 **NOT IN REFS**; Penny 2001 **NOT IN REFS**).

Climate and environment at Niah

The variety of depositional environments in the West Mouth during the Late Pleistocene, and the fluctuations in their character, are evident from the geomorphological record described in Chapter 3. Fine-grained calcareous airfall debris accumulated along the cave entrance lip (Lithofacies 2Ca–2Cf). Anthropogenic debris accumulated episodically, with episodes of re-working and perhaps erosion, *c.* 5–20 m further into the cave, in and around the rock overhang, to create the characteristic Lithofacies 4 'Brown silts with anthropogenic deposits' and their several distinctive local variants (e.g. Lithofacies 4/2, 4/2g, 4?). Distinctive patches of guano rich in wood ash from fires accumulated on the aggrading cave floor (Lithofacies GW). Deeper into the interior of the North Chamber, guano continued to develop as discrete layers of bat and bird droppings raised and enlarged the guano pile. The integrity of the latter failed episodically through shallow faulting and folding, events that might indicate intermittent near-surface saturation. There were also times of sub-surface chemical precipitation of gypsum blocks, however, perhaps pointing to occasional drier conditions (Lithofacies GM4-2). On this aggrading guano surface, bone-rich middens sometimes accumulated; elsewhere, occasional small streams or rivulets took water westwards towards the cave entrance (Lithofacies GF and 5).

The vegetational and climatic history of the vicinity of the Great Cave between *c.* 40,000 BP and 11,500 BP determined from the evidence of pollen (CH) and phytoliths (LK) in the West Mouth can be summarized as follows.

Pollen extracted from Lithofacies 3 indicates that the surface sediments that became the guano mudflow were deposited during an episode of cool and dry climate. Montane and lowland forest species were also prevalent during this period (Table 3.2: pollen biozone M-1).

For *c.* 6000 years after the mudflow, until some time after 35,000 BP (OxA-11303), the vegetation outside the cave entrance comprised lowland closed-canopy rainforest growing in a relatively warm and moist climate, perhaps not too dissimilar to that of the present day, with mangroves (*Avicennia*) and hence inter-tidal waters somewhere nearby (pollen biozone M-2). Ocean-levels were comparatively high. Some time later, significant swamp forest also developed (pollen biozones EA-1). The wet closed-canopy rainforest recognized in these pollen biozones correlates well with the regional evidence discussed above.

The warm-hot and wet climate remained broadly the same as in the preceding period, but at this time people practised localized and small-scale burning of

some forest edges near the cave entrance, prompting the local growth of the fire-tolerant *Justicia*. The land-snail fauna recovered from West Mouth deposits of this phase also indicate the presence of moist closed-canopy environments. Overall, there is little or no evidence of more open or drier habitats hereabouts at this time, rather the opposite: extensive wet closed-canopy forest, sometimes with swamp forest, dominated. Such environments correlate with the types of habitats inferred from the re-examination of the vertebrate and invertebrate remains from the lower components of Lithofacies 4 described later in this chapter.

Later, but at an unknown point in time before c. 23,500 BP (OxA-11550: 23,086–23,859 BP), the climate became significantly drier and notably cooler. Savannah-type vegetation — with patches of scrub or woodland and intervening open grasslands — existed beyond the cave entrance (pollen biozone EA-2). There is no microfossil evidence of wet closed-canopy forest, swamp forest, mangroves or the open sea being in the vicinity of the caves at this time. Subsequently, but also before c. 23,500 BP, dry forest developed together with savannah-type vegetation and, importantly, some montane vegetation-types (pollen biozones EA-2, EA-3). At this time the climate at Niah is estimated to have cooled to an average c. 6° C below the present. Precipitation may have been 30–60 per cent below current quantities.

Dry montane forest developed around Niah after c. 23,500 BP (pollen biozone RS-3), perhaps in response to a small increase in precipitation and perhaps temperature. The palynological evidence broadly confirms the suggestions put forward by Lord Medway (1964a; 1966a; 1977NOT IN REFS; Cranbrook 1986) and Terry Harrison (1996) from their studies of the (then poorly dated) vertebrate fauna that the local landscape during the LGM and for an unknown period afterwards comprised drier and relatively open vegetation types. Other factors as well as climate favoured the mix of vegetation types present in pollen biozones EA-2 to RS-3, including: the diversity of the local terrain (isolated limestone massifs and hills, steep cliffs, gorges, valleys, alluvial plains, basins and former coastal barriers); differing soil types; networks of rivers, streams, and large wetland sites; and the impacts of people.

Certainly the changes in habitat implied by pollen biozones EA-2 and 3 and RS3 could, in principle, have offered what appear to be profound advantages for many aspects of any contemporary human life and activity at Niah. There would, for example, have been landscapes that were more readily examined for food and water from afar and that were more readily traversed by people. Human movement in the region

during these times no longer has to be envisioned primarily in terms of movement along rivers through dense lowland rainforest. These apparent advantages, however, do not appear to be manifest in the nature or abundance of the contemporary archaeological and zooarchaeological evidence recovered from the West Mouth, as discussed later in the chapter.

From the end of these biozones to sometime before c. 8600 BP the local climate warmed significantly (pollen biozones RS-5 and EA-4, both poorly dated and with poorly preserved pollen assemblages). It appears that the landscape remained sufficiently dry to sustain dryland forest with some patches of open vegetation, rather than continuous wet lowland rainforest. The montane elements previously in evidence disappear from the pollen record. Eventually lowland forest species started to dominate the landscape. Detailed palynological evidence for the development during the later phases of the Late Pleistocene of the lowland rainforest and mangrove vegetation that exists today is not represented in the cave entrance sequence, but such vegetation has been found in sediment cores of Early Holocene date taken near the Niah Caves, as described in the next chapter: by c. 9400 BP mangrove forest dominated the Niah landscape as the coastlines transgressed the former coastal plain to the Gunung Subis.

The geomorphological and palynological evidence from Niah agrees surprisingly well with the regional data for climate and vegetation change, whether of past precipitation from the isotope geochemistry of cave speleothems at Mulu (Partin *et al.* 2007), or from palynological studies (Wang *et al.* 2009), though detailed comparisons are not straightforward because of differences in the locations and types of sites studied. The closest pollen and phytolith diagrams of Late Pleistocene age from the modern floor of the South China Sea are c. 300 km to the north of Niah, and the former mouth of the Molengraaf River is c. 400–500 km to the west (Sun & Li 1999; Sun *et al.* 1999; 2000; Wang *et al.* 2007; 2009). Nevertheless, bearing in mind the totally different sedimentary and taphonomic processes responsible for many of the microfossil assemblages from these seafloor cores, their compositions are broadly in sympathy with the palaeoecological evidence from the West Mouth. The Niah pollen record correlates better with the marked (7–11°C) temperature fluctuations proposed by Kershaw *et al.* (2007) for the LGM than with the smaller values proposed by Pickett *et al.* (2004), and the drier and more open landscapes of pollen zones EA-2, EA-3 and RS-3 fit the pattern of climate change inferred from the Mulu speleothems (Partin *et al.* 2007) much better than the ‘transitional hill forest’ proposed by the simulations of Cannon *et al.*

(2009). The lack of any observed rapid return of lowland rainforest after the LGM also fits the Mulu speleothem evidence. The rapid fluctuations in vegetation through the Late Pleistocene parallel those observed on Flores (Westaway *et al.* 2009 **NOT IN REFS**), though the wetter episode noted at Liang Bua *c.* 18,000 BP is not evidenced at Niah.

The Niah landscape in the Late Pleistocene

Current hydrographic and seismic research suggests that the sea was much closer to the vicinity of Niah before and after the LGM than previously suspected (Hunt *et al.* 2006; and Volume 2, Chapter 7). High-precision satellite mapping implies that beneath the modern blanket of Late Pleistocene and Holocene marine muds are complex terrestrial and coastal landscapes with incised ancient valleys and enclosed basins, and hills of various dimensions (Sathiamurthy & Voris 2006). One such buried topographic feature must be the (now) buried channel of the Sungai ('river') Niah. The edges of elongate features that cross the modern continental shelf are approximately aligned with the modern on-shore route of the river and are likely to mark the margins of the former incised valley of the Sungai Niah.

The coastal physiography of the mouth of the Sungai Niah, where it met the South China Sea during the LGM, is unknown and can only be speculated upon. Given that it would have been a much smaller river than the proto-Baram or Molengraaff, the Sungai Niah may not have had the large complex deltaic and riverine landforms identified with these rivers (Hiscott 2001; 2003; Hanebuth & Statterger 2003b). There may have been some topographic combination of the modern estuary of the Niah with those of the smaller rivers within the modern delta of the Rajang river *c.* 350 km along the shoreline, west-southwest of Niah (Staub & Esterle 1994; Staub & Gastaldo 2003). At the latter sites, modern estuarine waters enter the sea along incised channels that cross a series of contemporary or older linear coastal landforms and swamps that are often aligned parallel to the shoreline. The relatively stable sea levels in the order of *c.* 120 m below present during the 5000–6000 years of the LGM are likely to have created a measure of topographic stability, favouring the establishment of mangrove forest and other coastal vegetation types (Wang *et al.* 2009). Seismic studies of the continental shelf off the mouth of the present Sungai Baram (Hiscott 2001; 2003) suggest that, during the LGM, the mouth of the Sungai Niah may have been only some 30–10 km west of the more complex and far larger mouth of the Baram.

The combination of these surveys with coring and microfossil studies at the lake of Loagan Bunut inland

of Niah (Hunt *et al.* 2006), which found clear evidence of coastal mangrove vegetation, demonstrates the massive dimensions and extent of the buried channel that the Sungai Baram created both offshore of modern Miri and extending inland beyond Marudi to Loagan Bunut. At this time, the Niah Caves would have been at the western margins of a large headland with sea on three sides, the dryland route from which was to the south (Fig. 5.4). Long inlets of the sea or mangrove-rich tidal lagoons could also have reached far up the valley of the Sungai Niah surprisingly close to the Niah outcrop at various times before and after, though not during, the LGM. Inter-tidal mangroves, for example, were close enough to Niah for mangrove pollen to be deposited in the West Mouth within pollen biozone M-2, that is, after *c.* 35,000 BP and well before the broadly-defined LGM. Much later, around the Pleistocene/Holocene transition, brackish waters were again sufficiently close for people to be able to harvest the mollusc *Polymesoda erosa* and discard the shells in the entrance to the West Mouth (Stephens *et al.* 2008 **NOT IN REFS**).

On land, adjacent to the ancient valley and/or inlet of the sea of the proto-Sungai Niah, there were numerous large enclosed basins of differing sizes and depths on the exposed continental shelf. Only 30–40 km west of Niah, for example, there was a large basin measuring at least 20–30 km across, and tens of metres in depth; it must have been above sea level and filled with water and fringing swamp communities for thousands of years. Many other smaller basins existed. Whilst the precise nature and origins of these basins are uncertain, the hydrographic surveys by Sathiamurthy and Voris (2006) indicate that the exposed continental shelf would have contained large numbers of lagoons, lakes and pools, probably with innumerable streams and rivers, together with open water, marsh, bog, swamp-forest and riverine forests. In times of sustained dry weather, mudflats (or even salt-flats) could have formed within them. The breaching of these topographic features by rising sea levels after the LGM would have created a changing complex of indented and irregularly shaped shorelines, with temporary islands and deeper basins offshore, headlands, large embayments, and sheltered shallow coastal inlets. Whilst it is clear that mangroves also grew at the coastal edge before and after the LGM (Hanebuth & Statterger 2003b **NOT IN REFS**; Wang *et al.* 2009; Zheng & Li 2000), the environmental consequences of the high rates of marine transgression that took place between 18,000 and 10,000 years ago, especially in the exposed and flatter areas of Sundaland, might sometimes have been too rapid to permit the substantial establishment of large spreads of mangrove, swamp or similar coastal habitats (Woodroffe 1990).

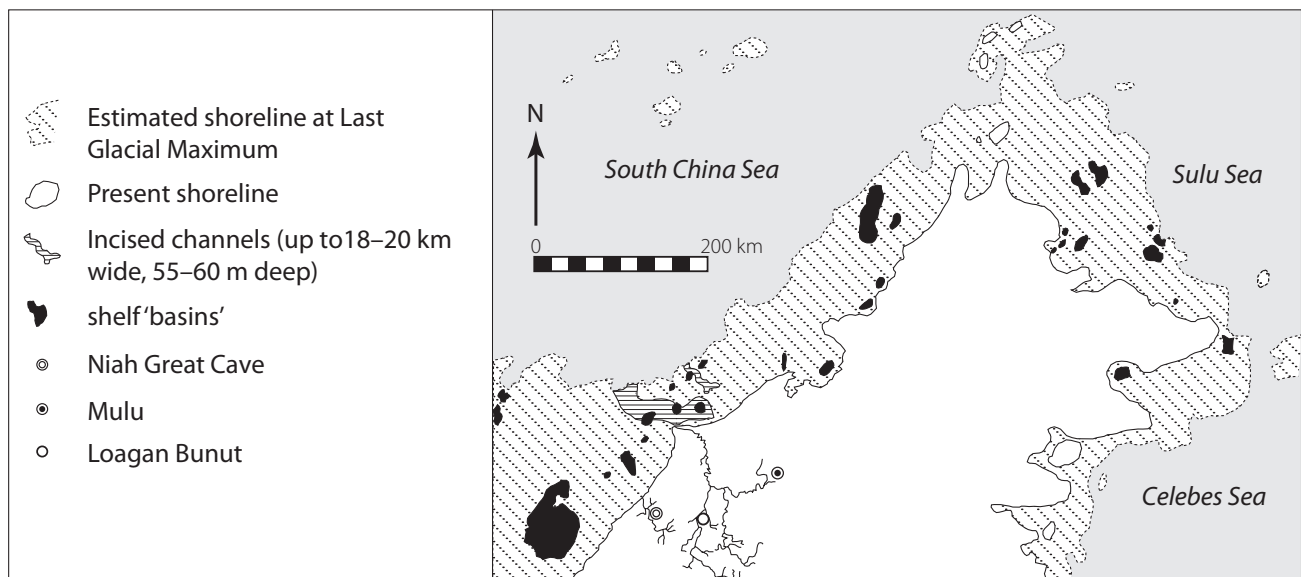


Figure 5.4. Reconstruction of the terrestrial and coastal physiography around Niah at the Last Glacial Maximum. (Reconstruction: David Gilbertson and Chris Hunt; illustration: Christopher Stimpson.)

Sedimentary and cultural sequences

[HB, GB, PP, RR]

Given that most of Lithofacies 4 was removed in the original excavations, establishing the nature of human occupation in the Late Pleistocene necessitated a detailed review of the Harrison Excavation Archive, the investigation (cleaning and sampling, with minimal excavation) of a series of standing sections, and a small-scale investigation of 'Block B', the sediment block at the back of the rock overhang (Figs. 2.41, 3.25, 3.26). In the former task we focused mostly on Harrison grid squares within our Area A (Fig. 5.5), underneath and in front of the rock overhang, because the evidence of the written records, photographs and section drawings suggested a degree of stratigraphic integrity and care in excavation and recording that gave most confidence about our ability to reconstruct and understand what had been there. As we described in Chapter 2, this confidence was subsequently confirmed by radiocarbon dating of charcoal samples from the spits in this part of the Harrison grid held in the Archive (Table 5.1).

We could do less with Area B, as the evidence of the standing sections and of the Archive confirmed that this has been used extensively in prehistory for the digging and subsequent filling of pits. This process meant that, whilst the pits were extremely interesting in terms of the activities represented by them, an individual spit excavated in this part of the West Mouth, cutting through a pit and the sediment

into which it had been dug, was likely to mix together cultural material of different ages (e.g. Fig. 5.18). The same was true of Area C, the Neolithic cemetery zone, given the disturbance caused by grave-digging. It is for these reasons that our studies of the finds from the Harrison excavations for the period discussed in this chapter focused especially on material from Area A. To these sources of data can also be added the Late Pleistocene occupation of the Lobang Hangu entrance, which we investigated by the same combination of studying the Harrison Excavation Archive and cleaning, recording, and sampling standing sections (Figs. 3.32 & 3.33). The analysis of the excavation records was also greatly informed by the study of the vertebrate faunal remains from the Harrison trenches by PP and RR, because factors such as the colour of bone surfaces, and degrees of weathering and exfoliation, were a significant guide to the coherence of bone assemblages from particular spits, and the likelihood of material of different origins and ages being mixed together (Volume 2, Chapter 20).

Area A

In March 1958 the Sarawak Museum began systematic excavation of the area to the north of trench E/B5, the last of the large trenches established in 1957. This expansion opened a total of 53 irregular-shaped trenches beneath and in front of the rock overhang. A series of test pits had been dug here the previous year to a depth of 24 inches (W, W2, X2, X3, Y3), 36 inches (Y) and 60 inches (X1) (Figs. 2.7, 2.9 & 2.10). Rather

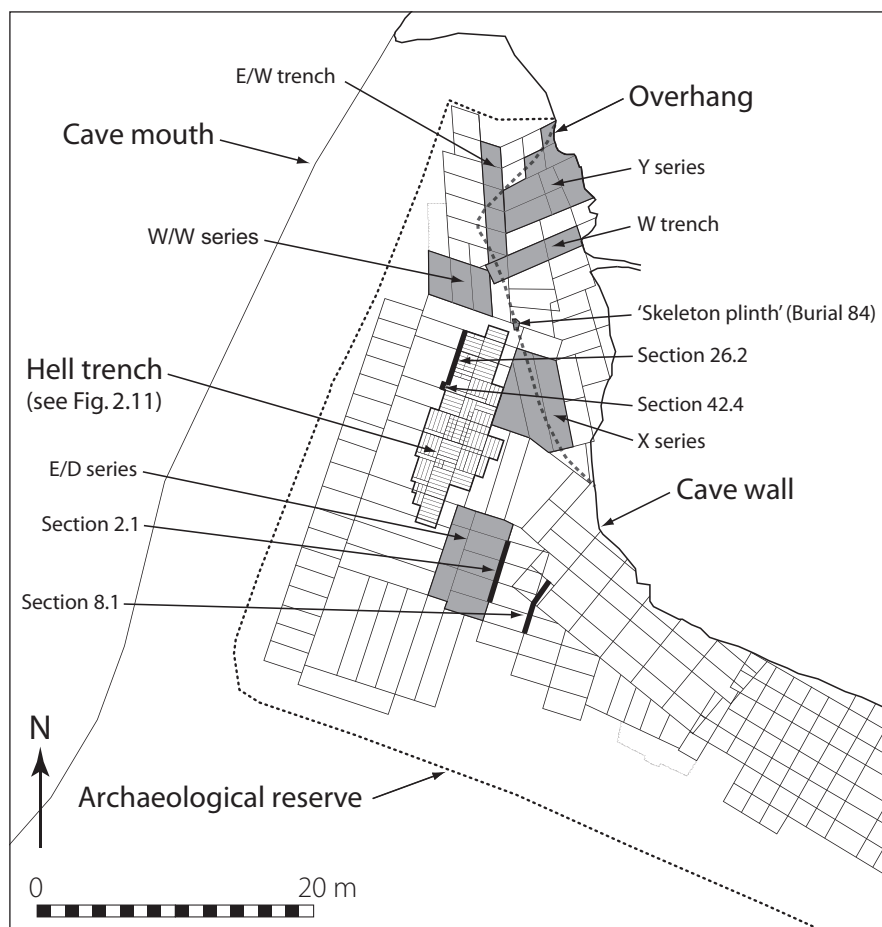


Figure 5.5. The archaeological reserve in the West Mouth of the Great Cave, showing the key locations and features discussed in Chapter 5.

than continuing with these trenches, a new series (E/W1–9) was opened, extending in a line approximately 45 degrees from the east–west alignment of E/B5. This first grid was laid out by Lord Medway. Together with the immediately adjacent W/W series, these squares are the most regularly laid out and best excavated (in 3-inch spits) of the Area A trenches (Fig. 5.6). The remainder were of varied and complex sizes and angles, and dug predominantly in 6- to 12-inch spits, suggesting that the excavation strategy here was less coordinated than elsewhere in the cave. Lord Medway’s notes from the time in response to Tom Harrison’s field directions are illuminating: ‘[his] instructions are conflicting and impossible ... I shall proceed as follows: along line E/W1 I shall construct a series of parallelograms ...’ (Harrison Excavation Archive Notebook 72, 2). The maximum depth excavated appears to have been determined by a decline in archaeological remains, usually at the reported appearance of the ‘pink and white’ sediment. Most trenches were halted at between 60 inches and 78

inches, though those closest to the cave wall were most deeply excavated, terminating at 144 inches below ground surface in the case of W5(b). By the middle of April 1958 Harrison’s workmen had removed almost all of the archaeological deposits from under the rock overhang with the exception of those in blocks Y/E1, Y/E2, W/W2, W/W3 and Y/Z1 (Fig. 5.7). These blocks were eventually excavated in the 1965 fieldwork season (Fig. 2.28), leaving just the three small columns of sediment we found in 2000: Blocks A and B against the back wall of the rock overhang and, just outside the drip line, a plinth on which a human skeleton (now much degraded) had been left, which we termed the ‘Skeleton plinth’.

No single trench had a complete sequence of charcoal samples in the Archive, but we were able to construct a near-complete sequence of radiocarbon dates, without reversals, through the Area A deposits by establishing sequences in adjoining trenches (Table 5.1), as well as obtaining further dates from charcoal that we collected from excavating the sampling col-

Figure 5.6. Excavations in 1958 of the E/W1-9 trenches at the entrance to the rock overhang, looking west (see also Fig. 2.14). (Harrison Excavation Archive photograph na 280, reproduced with permission of Sarawak Museum.)

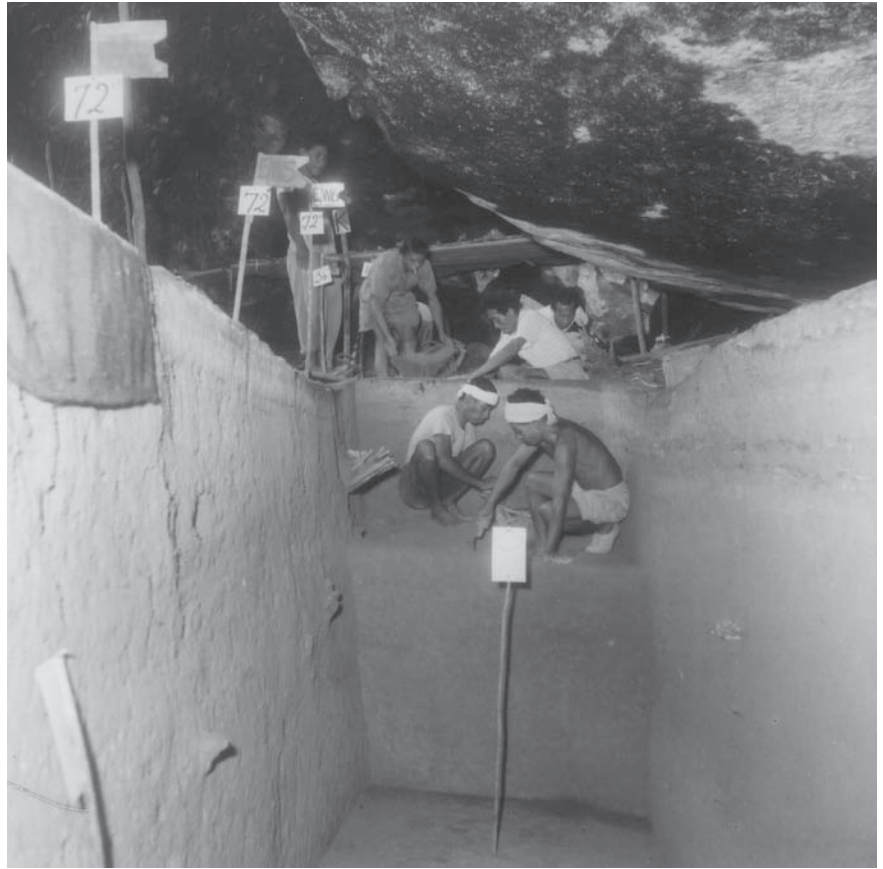


Figure 5.7. Block Y/E3, prior to its excavation in 1965. The screen has been erected to protect a flexed burial (Burial 87 Fig. 5.5 SAYS BURIAL 84), left on a plinth. Looking north. (Harrison Excavation Archive photograph na 861, reproduced with permission of Sarawak Museum.)



Table 5.1. AMS radiocarbon dates obtained on charcoal in the Harrison Excavation Archive from trenches under and in front of the West Mouth rock overhang (Area A). The calibrated (calendar) dates are calculated using the Belfast calibration curve (Reimer et al. 2010 NOT IN REFS).

Trench	Depth (inches)	Material	Radiocarbon years bp	Calendar years cal. BP (2 σ)	Sample code
W3	0–12	Charcoal	1067±27	929–1054	OxA-15620
Y/E3	6–12	Charcoal	2309±27	2185–2356	OxA-15158
Y/E3	12–18	Charcoal	2676±27	2749–2844	OxA-15159
W3	12–24	Charcoal	3318±28	3473–3630	OxA-15156
Y/E3	18–24	Charcoal	2619±27	2724–2774	OxA-15160
Y/E3	30–36	Charcoal	7606±35	8354–8454	OxA-15161
W3	36–48	Charcoal	9995±40	11,270–11,698	OxA-15157
Y/E3	48–54	Charcoal	13,745±55	16,704–17,042	OxA-15162
Y/E3	60–66	Charcoal	35,890±250	40,489–41,613	OxA-15163
W/E2	72–78	Charcoal	36,470±250	41,089–41,978	OxA-15164

umns in Blocks A and B. Three broad phases of activity can be discerned from the radiocarbon dates. The earliest calibrated dates, which are in the range of c. 42,000–41,000 BP with an outlier at 46,321–49,593 BP (OxA-V-2076-15), point to an early phase of activity; the dates probably represent the northernmost vestiges of the initial occupation centred within the Hell Trench area that was discussed in detail in Chapter 4. The sediment blocks we investigated at the back of the rock overhang yielded Late Pleistocene dates of 27,960±200 bp or 31,528–32,822 BP (OxA-11034) from Block A (context 1027; Fig. 3.16) and 19,650±90 bp or 23,086–23,859 BP (OxA-11550) from Block B (context 1020; Fig. 3.25), but the layers were generally associated with very little cultural material. It appears that there was an hiatus or decline in human activity in this part of the cave after the Lithofacies 3 mudflow, between (very roughly) 35,000 BP and 20,000 BP, during which time 6–12 inches (c. 0.15–0.3 m) of sediment accumulated.

A shift to a significant human presence in this part of the West Mouth followed the LGM. This second major phase of activity is marked by the date of 13,745±55 bp or 16,704–17,042 BP (OxA-15162) from spit 48–54 inches in trench Y/E3, associated with the deposition of a large assemblage of vertebrate bones. The latter continues into the spits between 48 inches and 30 inches, from which we obtained Early Holocene dates of 9995±40 bp or 11,270–11,698 BP (OxA-15157) and 7606±35 bp or 8354–8454 BP (OxA-15161), as well as the date of 8630±45 bp or 9350–9688 BP (OxA-11549) from Block B (context 1015). The amount of faunal material and other cultural debris associated with these dates suggests repeated visits to this part of the cave between about 17,000 BP and 8000 BP, in the Terminal Pleistocene and beginning of the Holocene. The likelihood is that, although depths will have varied between different trenches, as an approximate guide the material in the spits between about 60 inches and 48 inches in the central Area A trenches was depos-

ited in the Late Pleistocene, during the comparatively cooler conditions that followed the LGM, and that the material in the spits between about 48 inches and 24 inches dates to the Early Holocene.

The archive records of the excavation of block or trench Y/E3, excavated to a maximum depth of 66 inches (Fig. 5.8), were key to the dating and reconstruction of human activity in Area A. This trench is notable for containing three flexed human burials that were drawn with some estimation of the surface from which the burial pits were dug, from which we conclude that they were Early Holocene in date (see Chapter 6). There are no surviving plinths of sediment nearby, but three of its four sections were drawn after excavation (Fig. 5.9), and the notebooks contain relatively detailed descriptions of the sediments (Table 5.2). All of the deposits within the trench appear to display a sinuous curve in the section drawings, indicating that the horizontal spits used to excavate it will have caused some stratigraphic mixing. However, it is possible to propose a general stratigraphic sequence for the trench by combining the spit descriptions, the section drawings, and the radiocarbon dates we obtained from the charcoal samples in the Harrison Excavation Archive.

At the base, at 66–63 inches in depth, was sticky hard ground, where excavation ceased. The charcoal from the 66–60 inches spit that yielded the radiocarbon date of 35,890 ±250 bp or 40,489–41,613 BP (OxA-15163) probably derives from this layer, rather than from the deepest cultural material that was found in the overlying (63–36 inches) ‘light and dark brown loose’ sediments, clearly attributable to our Lithofacies 4. This unit, from which we obtained the Late Pleistocene date of 13,745±55 bp or 16,704–17,042 BP (OxA-15162) from 54–48 inches, contained quantities of artefactual and faunal material suggesting a phase of relatively intense occupation. The junction between Pleistocene and Holocene layers in this trench probably occurs within the upper part of this unit, at 42–36 inches in

Table 5.2. *Sediment descriptions in the Harrison excavation notebooks for trench Y/E3. ARE THE DESCRIPTIONS STRAIGHT QUOTES? THEY READ A LITTLE ODDLY - DORA*

Depth (inches)	Sediment description
0–6	Soil a mixture of dark brown on top 0-2" and gradually white nodule and light brown scattered in the trench.
6–12	Soil light brown with white nodule scattered and quite loose. Layer of ash and charcoal stretching from the end between the border of Y/E2 and to the other end of Y/E3.
12–18	Soil light brown with a bit of ash and charcoal- we are in fact at the middle of ash layer and the soil is very loose. I took one bag sample of ash mixed with soil. But the soil seems to change after [nearly finish with the] layer of ash, it began to get hard.
18–24	Soil light brown quite loose towards W/E3, but hard towards Y/E2 at the other end of Y/E3, and almost at the end of ash layer. Bone seems to be coming out at this layer, but pottery less.
24–30	The soil is light brown, and getting a bit loose after the hard part from 18- 24" finished. There is no more charcoal in this layer and no pottery as well except bat bone only with one teeth, but shell are coming out plenty.
30–36	Soil still light brown and quite loose towards Y/E2 border, and a bit dark brown towards the other end near W/E3.
36–42	Soil still dark brown toward W/E3 and quite light brown and damp towards Y/E2 that is the border of Y/E3 and Y/E2. In some area the soil tends very loose, but quite hard and sticky in some places as well.
42–48	Soil at this depth still dark brown near W/E3, and quite loose, where as near Y/E2 it still light brown and pretty hard.
48–54	Soil dark brown at W/E3 junction and quite loose where as towards Y/E2 light brown and quite damp, and still in shell deposit.
54–60	Soil still dark brown at W/E3 junction almost to the middle of Y/E3 and then the other half of the trench gradually turn to light brown soil and damp and pretty hard, where as the other end tends to be a bit soft in some part. Pieces of yellow clay now appeared just under the dark brown soil scattered around near the edge of Y/E3 and W/E3. It continues getting light brown clay and quite damp. Shells are gradually getting less from this level.
60–66	The soil at this level is light brown almost all through except on the edge of Y/E3 towards W/E3 a bit dark brown in colour. It seems quite loose and yellow clay still scattered about the trench. The soil at the depth of 63" seems to change into sticky and hard ground.



Figure 5.8. *Excavation of block Y/E3, under the rock overhang, in 1965. Looking southeast (see also Fig. 2.28). (Harrison Excavation Archive photograph na 869, reproduced with permission of Sarawak Museum.)*

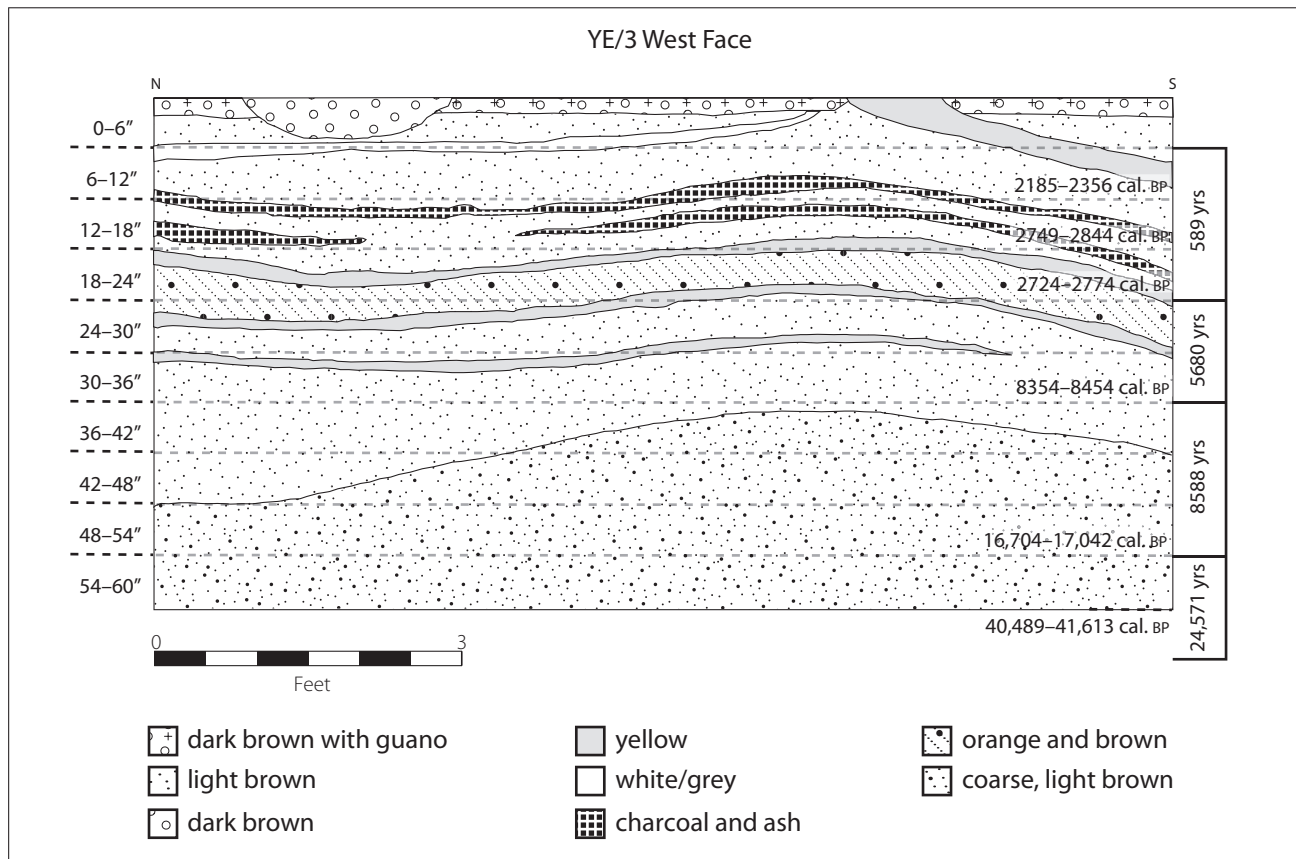


Figure 5.9. Section drawing of the west face of grid square Y/E3, redrawn from the 1965 sketch (reproduced with permission of Sarawak Museum) with the radiocarbon dates obtained by the present project from charcoal in the Harrison Excavation Archive added. (Illustration: Huw Barton and Christopher Stimpson.)

depth, where the excavators describe two sedimentary units and the section drawings suggest that there was an undulating interface between them.

The artefacts from Y/E3 consist predominantly of un-retouched flakes, together with single core and flake fragments (Table 5.3). There appears to have been a noticeable increase in activity at 48–60 inches in depth, following the LGM. At this depth, the assemblage was dominated by flakes and flake fragments only. One formal tool, a rubber/grinder, was recovered from the spit above, but given the undulating nature of the deposits here, this could have come from material much closer in age to the next (Holocene) radiocarbon date in the sequence.

Trench W3, measuring 10 feet by 5 feet 4 inches and dug in 12-inch spits, was located to the east and slightly south of Y/E3, under the rock overhang. The upper spits were excavated during the 1957 season. The lower spits, below 72 inches, were excavated in 1965 and section drawings and sediment descriptions are available for them. The upper layers are primarily

described in terms of artefact content rather than sediments, but there appear to have been several phases of intense human activity and perhaps two phases of abandonment. A notebook section drawing of the eastern wall of W2 shows a layer of grey ash and charcoal at 6–12 inches that appears to dip sharply at the northern end of the square (Fig. 5.10). The sedimentary descriptions (Table 5.4) refer to several discrete ashy lenses ('white ash', presumably Lithofacies 4/2g) between 72 inches and 96 inches, which are also indicated on the section drawing, and to a large area of burning and ash ('black or dark fire hearth') in the western corner of the square extending from 72 inches to the base of the excavation at 102 inches. While it is not clear from the section drawings, the descriptions suggest that this 'hearth' might be an intrusive feature such as a pit cut from higher up. The lowest radiocarbon date obtained on archived charcoal from this trench, of 9995±40 bp or 11,270–11,698 BP (OxA-15157), is from 48–36 inches. Given the dates of 7606±35 bp or 8354–8454 BP (OxA-15161) at 36–30 inches and

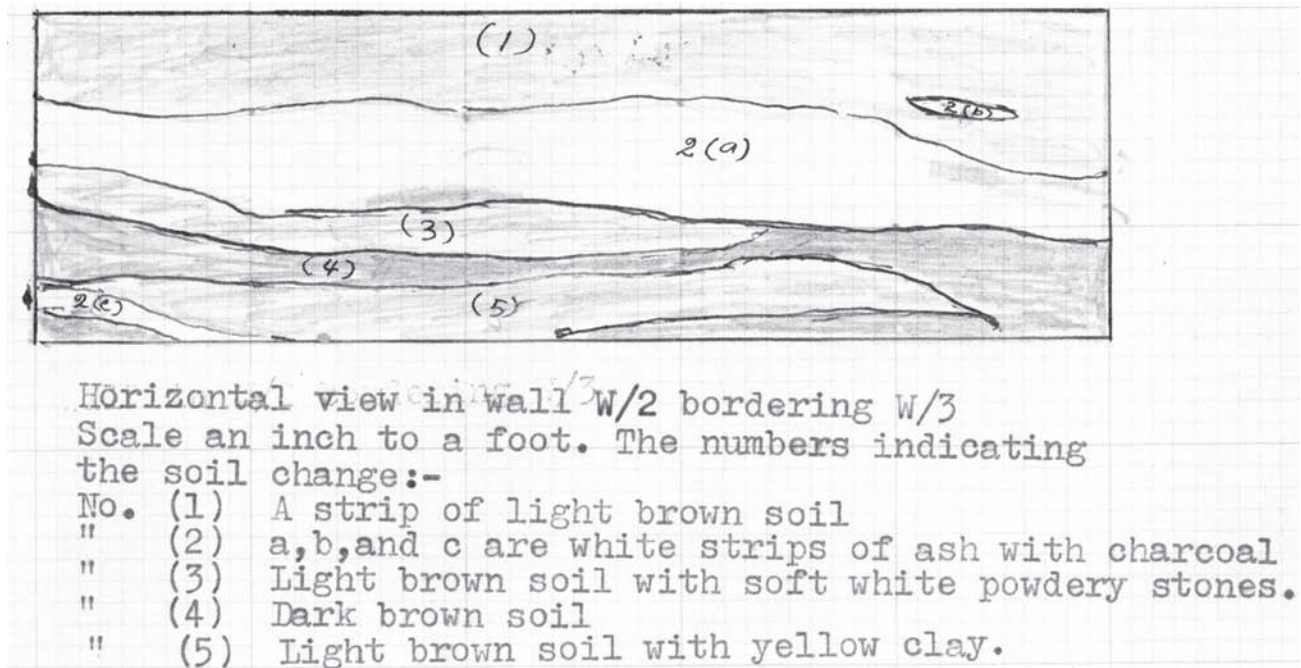


Figure 5.10. A notebook section drawing of the eastern wall of W2. 2a–2c denote lenses of ‘white ash’. (Harrison Excavation Archive Notebook 56, fig. 1, reproduced with permission of Sarawak Museum.)

Table 5.3. Lithic and ceramic artefact distributions recorded for trench Y/E3, from data in the Harrison Excavation Archive. The details of the radiocarbon dates are given in Table 5.1. I HAD TO FIX THE TOTALS COLUMN/ROWS SO THEY ADDED UP - DORA

Depth (inches)	Flake	Flake fragment	Fragment	Plaqueette	Rubber/Grinder	Manuport	Total	Pottery	Radiocarbon years bp	Calendar years cal. BP (2 σ)	Sample code
0–12	1	-	3	1	-	-	5	101	2309±27	2185–2356	OxA-15158
12–24	-	2	3	-	-	-	5	102	2676±27; 2619±27	2749–2844; 2724–2774	OxA-15159; OxA-15160
24–36	-	-	2	-	-	-	2	0	7606±35	8354–8454	OxA-15161
36–48	3	-	6	-	1	1	11	0	-	-	-
48–60	7	2	8	1	-	2	20	0	13,745±55	16,704–17,042	OxA-15162
60–72	-	-	2	2	-	-	4	0	35,890±250	40,489–41,613	OxA-15163
Total	11	4	24	4	1	3	47	0			

Table 5.4. Sediment descriptions in the Harrison excavation notebooks for trench W3, below 72 inches in depth. ARE THE DESCRIPTIONS STRAIGHT QUOTES? THEY READ A LITTLE ODDLY - DORA

Depth (inches)	Sediment description
72–78	Soil seems to be very hard at the top, [that] 75" grey and quite and a mixture of ash and also yellow clay were scattered within the trench H. Strip of fire hearth began to expose just at the border of W/3 + W/4 where at their side wall it appeared very clear. A black fire heart was taken for a sample. As from 73" the soil changed into light brown except for the fire hearth it is still black soil.
78–84	The soil now is light brown almost all over the trench except for the black fire hearth. (See plan opposite page). More white ash now exposed from the depth of 81".
84–90	Soil a scattered of white-ash mixed up with light brown soil and the dark fire hearth. (See position of the soil colour opposite page.) It is quite loose and dry. The white ash that appeared @ 84" gradually disappeared from 87" and almost absent, except around the fire hearth there are still some more of that white ash around it. Otherwise most of the area now at 90" turned to light brown soil and getting a bit hard.
96–102	Soil light brown with clay almost all over, but the black fire place still in its position and getting scattered [much longer the previous depth].

Table 5.5. Lithic artefact distributions recorded for trench W3, from data in the Harrison Excavation Archive. The details of the radiocarbon dates are given in Table 5.1. **I HAD TO FIX THE TOTALS COLUMN/ROWS SO THEY ADDED UP - DORA**

Depth (inches)	Flake	Flake fragment	Fragment	Plaque	Hammer	Pounder	Smoothen/Hammer	Chopper	Sharpener	Manuport	Total	Radiocarbon years bp	Calendar years cal. BP (2 σ)	Sample code
0–12	-	-	-	-	1	-	-	-	-	-	1	1067±27	929–1054	OxA-15620
12–24	1	1	-	-	-	-	-	-	-	-	2	3318±28	3473–3630	OxA-15156
24–36	-	-	-	-	-	-	-	-	-	-	0	-	-	-
36–48	-	-	4	-	3	1	2	1	2	2	15	9995±40	11,270–11,698	OxA-15157
48–60	-	-	1	-	-	-	1	1	-	1	4			
60–72	-	-	-	-	-	-	-	-	-	-	0			
72–84	1	1	1	-	-	-	-	-	-	-	3			
84–96	1	2	1	1	-	-	-	-	-	-	5			
Total	3	4	7	1	4	1	3	2	2	3	30			

13,745±55 bp or 16,794–17,042 BP (OxA-15162) at 54–48 inches in the adjacent trench Y/E3, the lowest levels of trench W3 might well date to around 40,000–30,000 BP, the sediments between 60 and 48 inches are likely to date to the post-LGM Pleistocene, and those between 48 and 36 inches to the Early Holocene.

The distribution and character of the artefacts recovered from W3 show the same general pattern of distribution as in Y/E3 (Table 5.5). At the base of the trench, at 96–72 inches, the assemblage consists of low numbers of flakes and flake fragments. There then appears to have been a slight hiatus in occupation, followed by a resumption of artefact discard at the end of the Pleistocene (at 60–48 inches), and a significant expansion in this activity in the Early Holocene (at 48–36 inches). The Late Pleistocene and Early Holocene assemblages are both characterized by a wide range of implements and formal tools including smoothers/rubbers, pounders, hammer-stones and tools for the manufacture of polished stone.

Area B

Our intervention in Area B consisted of the careful cleaning and recording of a vulnerable narrow plinth of sediment, the western face of which was recorded as Section 2.1 (Figs. 2.36, 3.29, 5.11), and the west-facing trench wall about 2 m to its east (5 feet within the Harrison grid) as Section 8.1 (Figs. 3.12, 5.12). These sections contained one of the few cultural features in stratigraphic section, a remarkable series of humanly-dug intercutting pits with radiocarbon dates assigning them to the period of this chapter. Whilst the upper layers of Section 2.1 may have been removed during the original excavations, and may also have collapsed at some later point, photographs from the Harrison Excavation Archive show that these two areas of deposit contained quite similar stratigraphic profiles (Figs. 5.13, 5.14). Section 2.1 consisted of the easternmost extent

of trenches E/D7, E/D6 and E/D5. This area of the site, lying immediately south of the large E square, Harrison's first trench, was excavated in rectangular trenches measuring 10 × 4 feet and dug in spits of 12 inches. Our Section 8.1 probably marks the easternmost extent of the Harrison squares C/D7 and C/D6 **ON THE PLAN (Fig. 5.5) IT LOOKS LIKE IT IS EAST OF C/D6, C/D5, C/D4 and N - DORA**. The excavation history of these squares is unclear, as the grid alignment used for the Neolithic cemetery overlaps them, but it is likely that they were originally marked out in the same proportions as the E/D trenches.

The quite detailed records that survive about the sediments excavated within the E/D trench series indicate that the general stratigraphic sequences were similar (Table 5.6), much as our studies of the surviving sections suggest (Chapter 3). In the latter (Fig. 3.31), the layers have an apparent dip south to north, perhaps following the dominant underlying surficial geology of the site and perhaps also influenced in part by the formation of guano mounds beneath areas of the cave roof with high densities of nesting birds and roosting bats. The two sequences likely both consisted of a complex series of pale ashy layers containing quantities of charcoal and artefacts (the 'ashy guano' – Lithofacies GW: Fig. 3.13), overlaying a hard or compact layer up to 2 feet thick. There is no age determination for the pale ashy layers in Section 2.1, but in Section 8.1 charcoal from the lower ashy layers, sealed by a compact layer interpreted as a palaeosurface, is dated (context 2075) to 17,770±65 bp or 20,592–21,512 cal. BP **APPENDIX 1 says 20,592–20,658 cal. BP -DORA** (OxA-V-2077-7), that is, at the end of the LGM. In areas undisturbed by pitting, this layer has an abrupt change above to the darker unit that we have categorized as Lithofacies 4. These deposits were described by the Harrissons as at 24–36 inches in depth below the ground surface. Lithofacies 4 varied

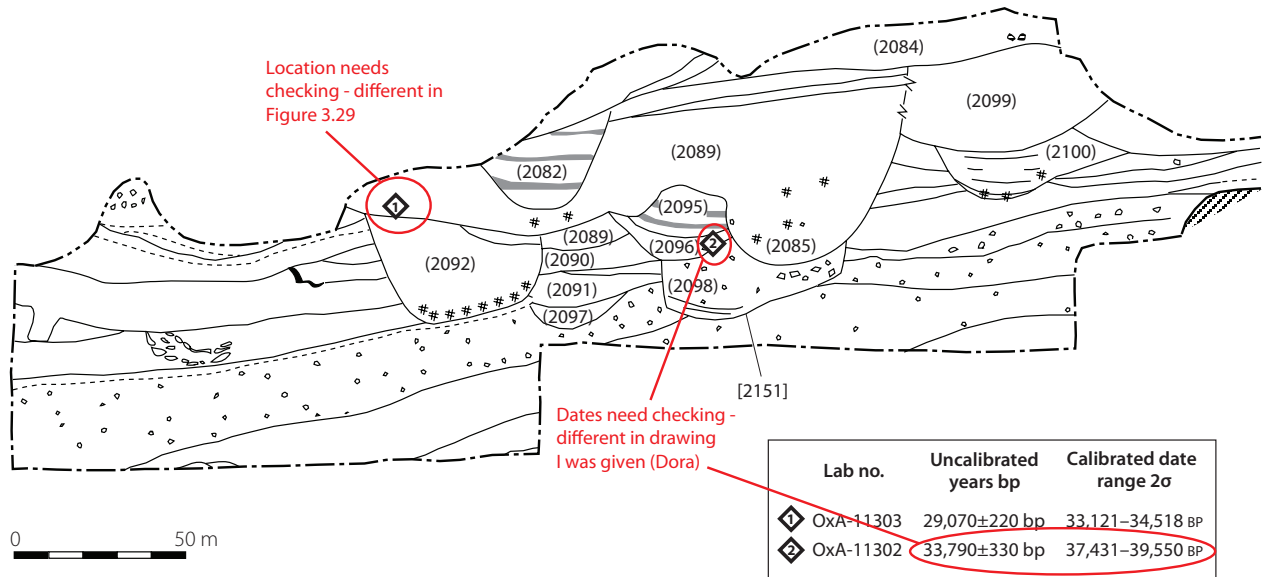


Figure 5.11. Section 2.1; see also Fig. 3.29. (Section drawing: Paula Whittaker and Mike Morley; illustration: Lucy Farr.)

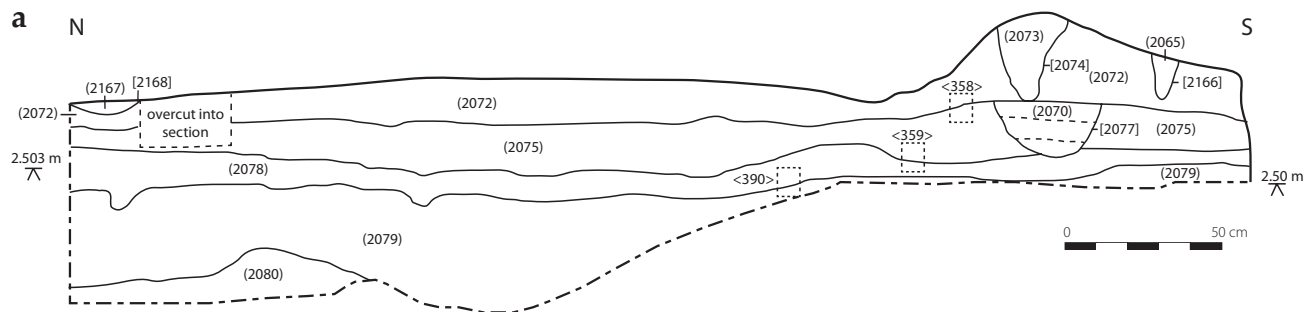


Figure 5.12. a) Section 8.1 in Area B, west-facing; b) southern end of Section 8.1, looking east; see also Figure 3.12. Scale: 30 cm. (Section drawing by Mark Trickett; illustration: Lucy Farr; photograph: Graeme Barker.)

Figure 5.13. Looking east over the Hell Trench into the Harrison excavations in our Area B, showing (on the left, in inches) the calculated depths below the ground surface, and the likely location of grid points. The 'ashy guano' thickening from right to left (south to north) is clearly visible as a blotchy white band. Pits are visible in the dark sediment below it. (Harrison Excavation Archive photograph na 1023, reproduced with permission of Sarawak Museum.)

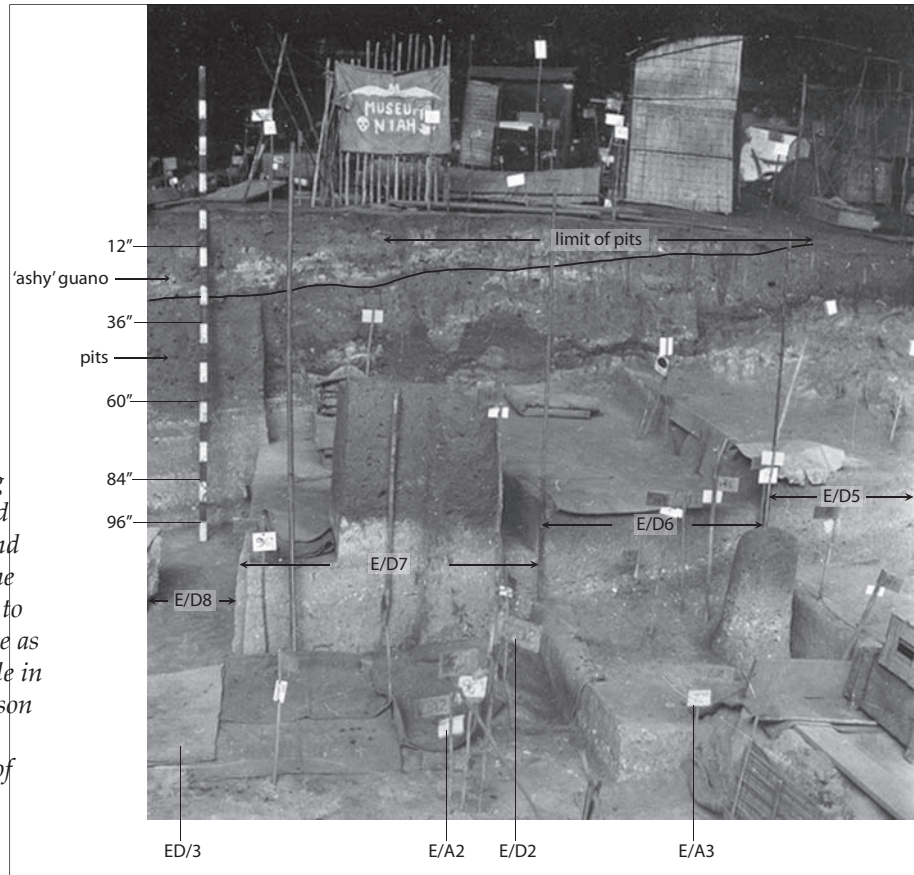


Figure 5.14. Looking southeast over the Hell Trench towards the cemetery zone (our Area C), showing the likely location of grid points. An 'ashy layer' is visible to the left of the figures by the 'umbrella', appearing to thicken with distance into the cave. (Harrison Excavation Archive photograph na 195, reproduced with permission of Sarawak Museum.)



Table 5.6. Descriptions in the Harrison excavation notebooks of deposits that can be associated with the pitting sequence identified in Sections 2.1 and 8.1 in Area B.

Depth (inches)	E/D8	E/D7	E/D6	E/D5
0–12	0–2" surface and crusted. 2–12" light and loose. Ash layer running at approx. 12 inches.	Surface, hard crusted, dark at 2–3 inches, loose, light and dry.	0–2" hard, dark humus layer. Below this, soil light and loose. Layer of grey soil, ash and charcoal runs throughout trench at approx. 2" depth.	Dark grey surface soil mixed with loose ash at 4" level. White greyish soil all the way down to the 12" level.
12–24	Light-loose soil, mixed with layer of greyish soil — with [unclear] charcoal. Sample of greyish soil tested with hydrochloric acid — found to be decomposed limestone.	Loose, dry, some charcoal and ash.		Dark loose soil at western part of trench. Bone, charcoal and ash mixed at 14" level. Charcoal and ash continued down to 16" level.
24–36	Light dry. Considerable fire activity and decomposed limestone through to 36".	Considerable charcoal and ash deposit throughout the layer.	Light loose to 36". Ash and charcoal layer encountered at 36". But sloping off at fast angle toward E/D7 — the ash and charcoal layer will be uncovered in 36–48".	The ash and charcoal layer was encountered in E/D5 at 33–36". It ran from the east of the trench to the middle. Had petered out by west side.
36–48	Earth light, loose, dry.	Soil continues light, loose, considerable fire activity. Patches of ash and charcoal in this layer.		Pink and white hit at 44–48" sterile.
48–60	Light and loose — throughout layer some indications of fire activity and decomposed limestone.	Rather loose soil down. Patches of white ash and some charcoal mixed in first 2". Loose soil mixed with many hard bits of earth. The soil gets hard at east part of trench, but soil loose at west part of trench as the first 6" layer.	Charcoal and ash half level. (right on hearth). Hard soil at SE corner of trench and soft earth at west part of trench.	
60–72	Soil at 60–62" loose, dry. Considerable ash and charcoal in eastern portion of trench. Pink and white sterile. At 70" pink and white all over of trench.			
72–84	Pink and white throughout trench. Absolutely sterile (at this depth).			
84–96	Pink and white throughout level. Completely sterile.			

in depth throughout most of the West Mouth, but appears to increase in thickness from south to north (Fig. 5.13) and west to east (Fig. 5.14). At the base of Lithofacies 4 in Sections 2.1 and 8.1 is either the hard compact deposit mentioned above or the reworked 'pink and white' (our Lithofacies 3R) described by the Harrissons as devoid of cultural material.

Section 2.1 appears to be a surviving remnant of the eastern wall of trenches E/D7 to E/D5. The upper layers of the section probably equate to the lower part of the ashy layers (Lithofacies GG8b) reported by the Harrissons at around 24 inches depth below the original cave floor. Charcoal from pit fills designated Lithofacies 4(?) in Section 2.1 returned radiocarbon ages of 33,790±330 bp or 37,341–39,550 cal. BP (OxA-11302;

context 2096) and 29,070±220 bp or 33,121–34,518 cal. BP (OxA-11303; context 2085), but it is unclear from which layer or layers these pits were originally cut. The radiocarbon date from the pit in Section 8.1 (context 2075 **CORRECT? Pit looks to be 2070 in section drawing - DORA**) of 17,770±65 bp or 20,592–21,512 cal. BP **APPENDIX 1 says 20,592–20,658 cal. BP -DORA** suggests that the pits in Section 2.1 might derive from components of Lithofacies 4 that accumulated after the LGM, though this inference remains insecure without a clear indication of the origin of the cuts. It could be argued that the charcoal in the pits has been re-worked from the earlier deposits into which the pits were cut, but it is now impossible to date the latter as the upper layers no longer exist. If the dated charcoal samples

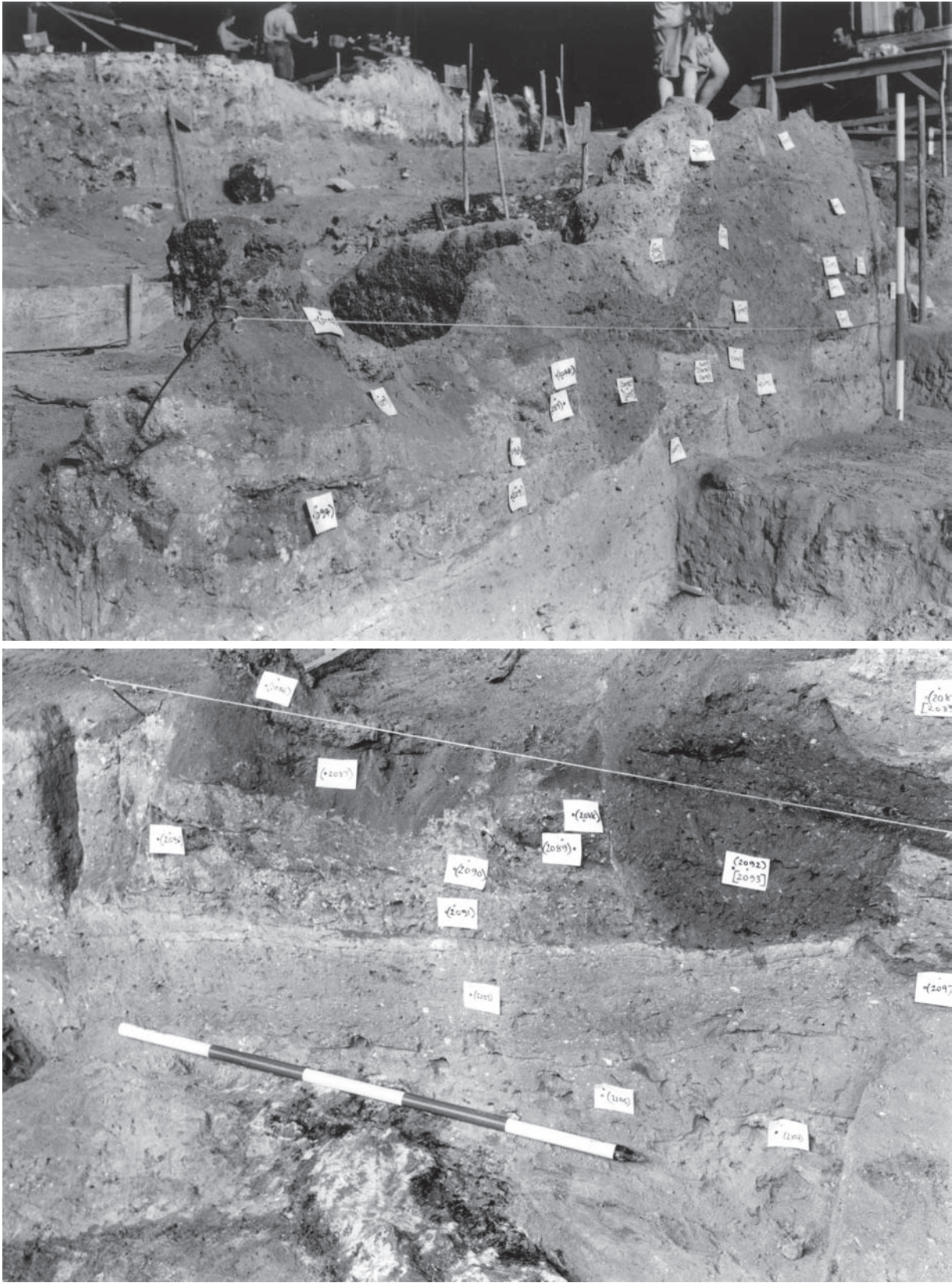


Figure 5.15. Detail of some of the Section 2.1 pits and their fills: (above) looking southeast; (below) looking east. Scales: 1 m. (Photographs: Graeme Barker.)



Figure 5.16. Section walls lying west of Section 2.1 (what may be squares E/A1 and E/A2 or possibly squares E/D3 and E/D2), without evidence of ashy layers. (Harrison Excavation Archive photograph na 1507, reproduced with permission of Sarawak Museum.) **IS THIS THE CORRECT IMAGE - see last page of proof for alternative - DORA**

from the pits do indeed derive from Lithofacies 4, they still provide us with useful ages to date this deposit and also fit our chronological expectations, given the antiquity of the lower mudflow event at around 35,000 BP. Although some of the pits contain homogeneous brown fills, visually most of the pit fills share more in common with the ashy layers into which all of them are cut, rather than with the more typical properties of the brown silt-rich variants of Lithofacies 4: they appear as pale and contain uneven white layers, some of which follow the profile of their pit floors (Fig. 5.15).

While the Lithofacies 4 sediments excavated by the Harrisons remained rich in charcoal following the end of the LGM, it seems likely that the character of occupation in the West Mouth changed given the evidence of the pale ashy layers (Lithofacies GF), which presumably signify a dramatic increase in burning in this part of the cave entrance. This activity appears to have diminished with time, as the ashy guano is overlain by a uniform layer of non-ashy material. The ash layer was not encountered in trench E/D8 until 12 inches below the ground surface (Table 5.2). The excavators of trench E/D5 noted that ‘... the ash and charcoal layer was encountered in E/D5 at 33–36 [inches]. It ran from the east of the trench to the middle. Had petered out by west side’ (Harrison Excavation Archive Notebook 103, 26). Archive photographs of section walls of what may be trenches E/A1 and E/A2, or possibly trenches E/D3 and E/D2, lying west of Section 2.1, do not appear to contain any evidence

of the ashy layers (Fig. 5.16). These and other photographs indicate that the sequence of intensive pitting observed in Section 2.1 was an activity that was spatially restricted: pits are not visible in Figure 5.16, or in the west-facing wall of trenches E/B3 and E/B4 (Figs. 1.24 & 5.19).

One of the few drawings of site stratigraphy made during the Harrison excavations, probably during the 1965 field season when the vertical organization of sedimentary units was being noted with greater consistency than previously, consists of the south-facing wall of trench E/D8 (Fig. 5.17). It is apparent that no pits were observed. Of course this square may have been beyond their spatial distribution, but it is noteworthy that the archive stratigraphic notes reproduced in Table 5.2 give no indication that pit features were being encountered during the excavation of the E/D trenches. It may be that attitudes toward sediment excavation here were biased by horizontal concerns such as ensuring spit depths were being maintained, even though horizontal and vertical variations in sediment distribution were noted by the excavators. It is also interesting that the wall containing the pit features was extensively photographed (Fig. 5.18): clearly the excavators thought that they were looking at something that needed recording, even though they did not realize that the complex colour and texture changes denoted the cutting and filling of pits.

In all of the photographs of this section there is a clear delineation between the ‘pink and white’ at

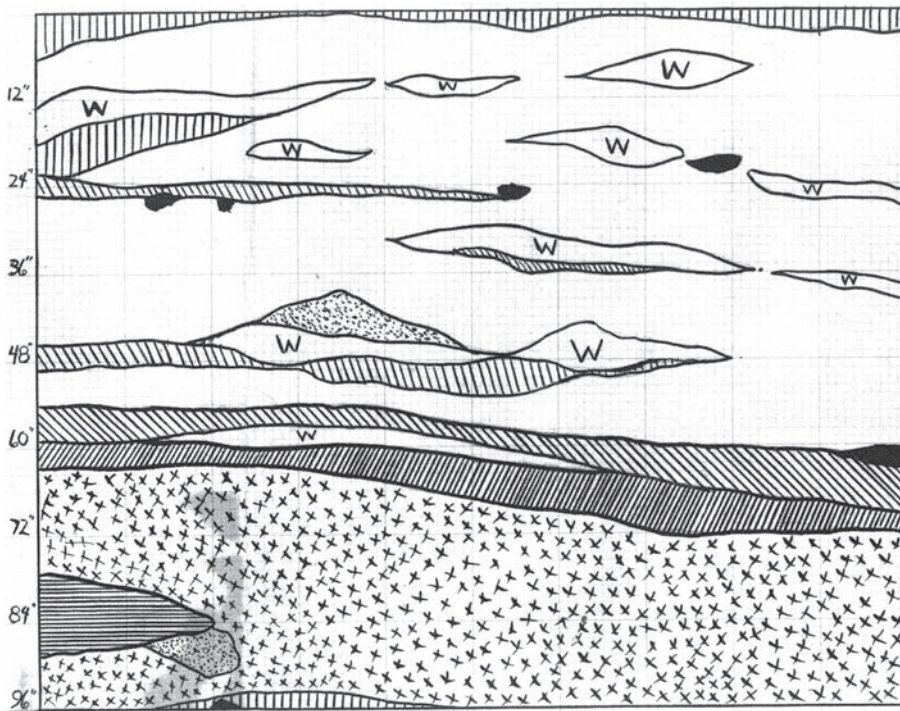


Figure 5.17. Stratigraphic drawing of the south-facing wall of square E/D8. (Drawing reproduced with permission of Sarawak Museum)



Figure 5.18. Excavation in progress in 1965 in front of the section we recorded as Section 2.1. The pits are clearly visible above the wooden box in the foreground and finds baskets behind. Looking southeast. (Harrison Excavation Archive photograph na 1021, reproduced with permission of Sarawak Museum.)

Table 5.7. *Artefact distributions (lithics, burnt clay, and burnt stone) in Harrison trench E/D7. I HAD TO FIX THE TOTALS COLUMN/ ROWS SO THEY ADDED UP - DORA*

Depth (inches)	Flake	Flake fragment	Fragment	Plaque	Hammer	Smoother/ Hammer	Chopper	Sharpener	Rubber/ Grinder	Adze/Axe	Burin	Biface	Manuport	Burnt clay	Burnt stone	Total (excl. clay)
0–12	3	2	6	1	-	-	-	-	1	1	-	-	-	-	3	17
12–24	-	-	6	2	1	1	1	1	3	1	-	-	-	-	3	19
24–36	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	4
36–48	5	3	5	2	-	-	-	-	-	-	-	-	3	-	2	20
48–60	2	-	1	-	-	-	-	-	-	-	-	1	-	-	-	4
60–72	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total	12	5	21	5	1	1	1	1	4	2	0	1	3	0	8	65

Table 5.8. *Artefact distributions (lithics, burnt clay, and burnt stones) in Harrison trench E/D8. I HAD TO FIX THE TOTALS COLUMN/ ROWS SO THEY ADDED UP - DORA*

Depth (inches)	Flake	Flake fragment	Fragment	Plaque	Core	Hammer	Smoother/ Hammer	Chopper	Sharpener	Rubber/ Grinder	Adze/ Axe	Burin	Biface	Manuport	Burnt clay	Burnt stone	Total (exc. clay)
0–12	4	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	7
12–24	-	1	3	-	1	-	-	-	-	1	-	1	-	3	-	8	18
24–36	1	1	1	-	-	-	-	-	-	-	-	-	-	-	7	-	3
36–48	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-	-	3
48–60	4	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	17
60–72	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5	6	7
72–84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
84–96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total	9	3	21	0	1	0	0	0	0	2	0	1	0	4	12	14	55

around 60 inches and the layers above. Above the ‘pink and white’ (Lithofacies 3/3R), the section drawing alludes to a series of sedimentary lenses and high concentrations of charcoal interpreted as ‘hearth’ deposits occurring amidst a ‘loose, grey-brown’ soil. The ‘heavy’ charcoal layer shown in the ‘pink and white’ at 84 inches depth is intriguing, but perhaps represents manganese staining of the type encountered throughout the lower levels of the Hell Trench (e.g. Lithofacies 2Cp in Sections 26.2 and 42.4). The relatively thick but horizontal lenses of ‘dark brown with ash and charcoal’ suggest repeated patterns of more intensive burning. They may represent relatively large fires, or repeated occupations for short periods of time interspersed by longer periods of less intense activity. The presence of a ‘hearth’ is also noted in trench E/D6 at 48–60 inches in depth. The strong charcoal signature throughout the excavated layers (Table 5.2) implies a relatively continuous human presence once Lithofacies 4 began to form here, though the nature of the excavation was not such as to be able to detect any variations in this.

The artefacts from trenches E/D7 and E/D8 in the Harrison Excavation Archive were re-analysed (by TR). It is possible that over the four decades since the Harrison excavations some artefacts have been inadvertently transferred to other experts and

archives, losses which may bias the data especially if any such removals have included items from the lower, older, levels which have been a prime focus of scholarly interest. For example, a site plan drawn on 14 August 1965 indicates the position of a ‘chopper’ at 58–60 inches on the floor of trench E/D8, and no such artefact was found by us in the Archive. This example may simply be a matter of identification, as our re-assessment of the artefacts revealed many examples of form imposed by previous researchers upon non-artefactual stone or flaking débitage. Seen in this light, the ‘chopper’ noted in trench E/D8 is more likely to have been one of the single or multi-platform pebble cores that we identified rather than a genuine chopper that has gone missing.

Artefacts for study were selected from trenches E/D8 and E/D7 because trenches E/D6 and E/D5 are likely to have been heavily disturbed by the digging of pits into Lithofacies 4. Overall, trench E/D8 is probably the least disturbed of the four. Interpreting depth trends here remains slightly problematic as deposits visibly dipped from south to north (Fig. 5.13) and may also have been dipping from east to west, though the 1965 section drawing implies that layers were relatively level in this area. There is a clear trend in artefact distribution by depth, with two ‘layers’

(spits as excavated, of course) having relatively high numbers of artefacts (Tables 5.7 & 5.8). In trench E/D7 these concentrations occur at 36–48 inches and 0–24 inches in depth. The lower layer would have been below the ashy grey layers, well within Lithofacies 4. Its assemblage is ‘informal’ like that of the earlier occupation at the site, composed of flakes and flake débitage only. The excavators noted that the artefacts at this level were associated with ‘considerable fire activity. Patches of ash and charcoal [were observed] in this layer’ (Harrison Excavation Archive Notebook 103, 26), and burnt stone was also recovered. Above this level, artefact frequencies drop off considerably, the assemblage consisting of a few stone fragments and a single flake. The upper phase of artefact concentration, above 24 inches in depth, is likely to be mid or late Holocene in date. In trench E/D8 the two lowest spits were both within the ‘pink and white’ deposit that was described as culturally sterile (Table 5.2). The high frequency of flake and flake débitage at 60–48 inches in depth in trench ED/8 is probably directly comparable to the material recorded one spit higher in trench E/D7, given the south to north dip in the Lithofacies 4 deposits. Above this spit, as in the other trench, artefact counts drop off, only recovering much later in the Holocene.

The Harrison E trenches

Interpreting the cultural sequence in the area of the E-series trenches (Figs. 2.38 & 5.5) is extremely difficult, because there is no surviving stratigraphic sequence, the original excavation trenches were large, and the excavators were attempting to keep them horizontal against the natural slope of the cave deposits. A photograph of the west-facing wall of the eastern end of trenches E/B3 and E/B4 indicates that, as with the E/D trenches, the layers had a marked dip from south to north (Figs. 1.24 & 5.19). This and other photographs in the Harrison Excavation Archive appear to show a complex series of events following the Lithofacies 3 mudflow, the ‘pink and white’ silts. Visible in the profile is a number of pit-like discolourations, but in this case it is unlikely that they are anthropogenic in origin: their surfaces, except in the extreme right of the images shown as Figure 5.19, do not contain fill from the upper, much darker, layers of Lithofacies 4. They may represent shallow channels resulting from water flow during a wetter period within the cave, perhaps related to the process of hydro-collapse due to extreme surface wetting described by Dykes (2007, and Volume 2, Chapter 5). The dipping bands evident in the photograph are within what appear to be three major sedimentary units. The angle of bedding seems relatively consistent in each, contrasting sharply

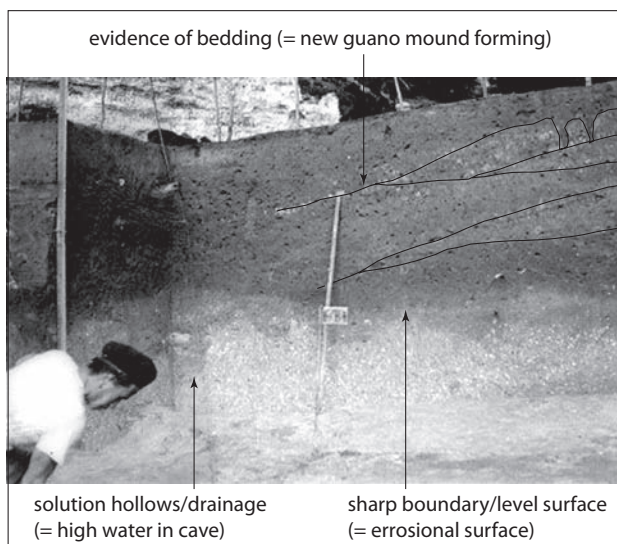


Figure 5.19. The west-facing wall of the eastern end of Trenches E/B3 and E/B4, showing what are probably gullies at the base of Lithofacies 3, and bands of guano, charcoal, and human detritus dipping from right to left (south to north) within Lithofacies 4. See also Figure 1.24. (Harrison Excavation Archive photograph na 1507, reproduced with permission of Sarawak Museum.)

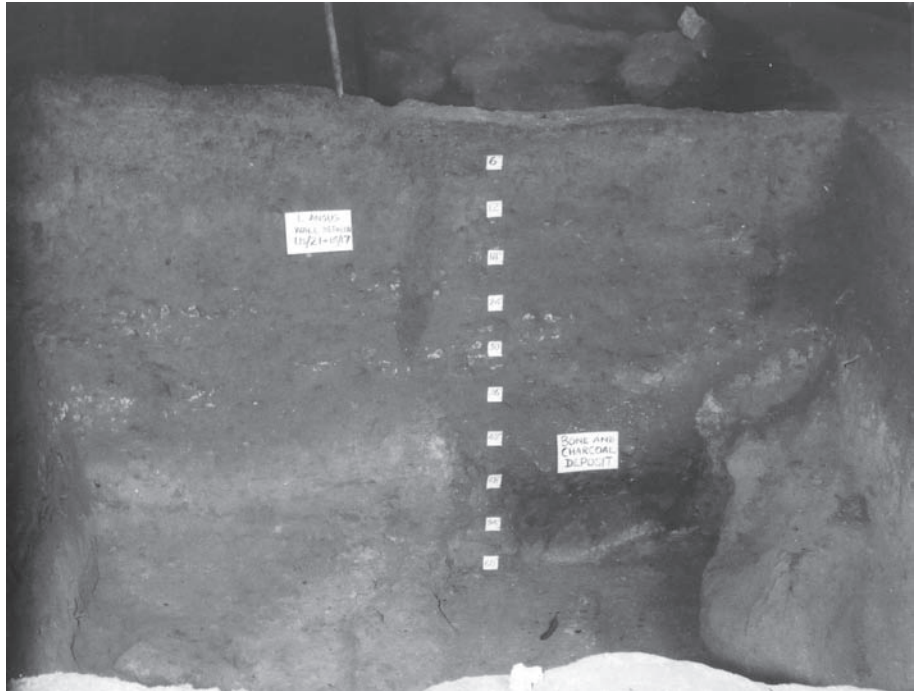
with the more horizontal though irregular surface of Lithofacies 3 below. The subsequent mixture of guano, charcoal and human detritus covering Lithofacies 3 seems to have built up from right to left, following the topography of the interior cave mound.

If the interpretation that Lithofacies 4 built up as a series of ever-widening mounds in this part of the cave mouth is correct, it has serious implications for attempting to reconstruct a cultural sequence based on the Harrison spit depths. It is uncertain whether there was a single major mound of guano somewhere in the vicinity of the E/D squares, or several mounds building up at different periods following changing roosting habits of birds and bats. However, what is certainly clear from Figures 1.14 and 5.13 is that attempting age/depth correlations across the entire site is impossible: moving diagonally upwards across squares E/D3 to E/D4 from right to left (south to north), the Lithofacies 4 deposits probably become gradually younger.

Lobang H Angus

The Harrison and NCP excavations in the Lobang H Angus entrance (Figs. 2.24, 2.25, 3.32 & 3.33) were described in Chapters 2 and 3, and the details need not be repeated here. The principal sediments of interest for this chapter are the dark (variously reddish and yellowish) brown silts and clays below the surface

Figure 5.20. Pit digging at Lobang H Angus: the south-facing baulk between Trenches US/21 and US/13, showing a pit (marked 'bone and charcoal deposit') associated with the Late Pleistocene occupation, cut into the basal greyish-brown clays. The vertical series of labels marks the spits in which the deposit was excavated. (Harrison Excavation Archive photograph *la 61 CORRECT?*, reproduced with permission of Sarawak Museum.)



layers containing Metal Age pottery and above the basal greyish-brown silty clays that yielded a radiocarbon date of $32,660 \pm 210$ bp or 36,583–38,059 cal. BP (OxA-13938). We obtained two radiocarbon dates from the intermediate deposits that assign them to the terminal Pleistocene following the LGM: context 1009 in the main area of the Harrison trenches was dated to $12,500 \pm 50$ bp or 14,206–15,061 cal. BP (OxA-13936), and contexts 1044 and 1045 in the test pit excavated c. 8 m northwest of the Harrison grid (Test Pit B) were dated respectively to $10,450 \pm 45$ bp or 12,135–12,550 cal. BP (OxA-13939) and $10,720 \pm 75$ bp or 13,050–12,560 cal. BP **12,444–12,811 cal. BP IN APPENDIX 1 - DORA** (OxA-14038). Although there is no evidence for the intensive burning found in the West Mouth in the Late Pleistocene, people clearly made regular use of the Lobang H Angus entrance, digging pits (Fig. 5.20) and discarding artefacts, charcoal and food refuse.

Discussion

The following interpretation is proposed for the character of Late Pleistocene occupation in the West Mouth and Lobang H Angus, combining the evidence of the sediment descriptions and drawings in the Harrison Excavation Archive, our own observations and dating of the lithofacies recognized, the changes in artefact frequency and type, and (discussed below) the frequency and character of faunal remains.

There may have been a short period of site abandonment in the front of the West Mouth (Areas A and B) after the guano mudflow c. 35,000 BP, with erosion

and reworking of the surface of Lithofacies 3 (Chapter 3: Lithofacies 3R). There are then strong indications of human activity: high quantities of charcoal, burnt stone and burnt clay, associated with pit digging and an informal flake assemblage much like that of the pre-mudflow occupation. If the dated charcoal in the Section 2.1 and Section 8.1 pits is re-worked from Lithofacies 4, then at least some of this material dates between c. 34,000 BP and c. 29,000 BP. Although it is possible that the 12-inch-thick spits used in the original excavations have masked changes in artefact densities, artefact numbers appear to have decreased significantly after this phase, though the layers continued to have significant quantities of charcoal.

Low intensity but repeated use of this part of the West Mouth was the dominant pattern of human occupation throughout the formation of Lithofacies 4. Following the LGM, however, there was a significant change in the character of activity here, marked by the deposition of ash-rich layers and increased numbers of burnt stone and clay probably indicative of more frequent, larger, and hotter fires. These developments were associated with a significant increase in artefact discard and assemblage diversity and with the first appearance of formal tools such as hammer-stones, pounders, and polishers that were to be the dominant stone technology in the Early Holocene. During the closing millennia of the Pleistocene the Lobang H Angus entrance was also used for occupation of intermediate intensity, activities including pit-digging.

Vertebrate fauna [PP, RR]

Area A

Vertebrate remains archived at the Sarawak Museum were chosen for zooarchaeological analysis from a sample of 26 of the original 53 trenches across Area A, representing 49 per cent of the total excavated area. The selection of trenches was based on three criteria. First, trenches were chosen to provide as much spatial coverage as possible in order to identify any possible patterning in bone concentration and represented taxa. Second, complete north–south and east–west transects were established for determining spatial/depth relationships in bone concentrations. Third, we focused on those trenches identified by Lord Medway in his 1958 field-notes as being the least disturbed.

The importance of a reference to the original bone assemblage composition became apparent during the early stages of analysis. During the 1958 excavations, Lord Medway had tabulated, in some detail, the exact numbers of small vertebrate remains and large mammal, reptile, and bird bones, including a column for ‘distinctive bones’, predominantly jaws and teeth, which were removed for further analysis. It was the formal identification of these distinctive fragments that was published by Medway (1958a). With the exception of these bone fragments, it is likely that the cloth bags in which the bulk of the bone assemblage was stored at the time of our analysis were those used during the original excavations and that they had not been re-opened since. This conclusion was supported by the close correlations between the numbers of fragments recorded in the original and NCP studies. Of the 15,080 bone fragments in the Harrison Excavation Archive recorded as deriving from Area A, 7100 of them — 47 per cent of the total assemblage — are associated with spits that can be assigned to the Late Pleistocene occupation under discussion with reasonable confidence. They accumulated primarily within the shallow depression under and in front of the rock overhang from c. 48 inches below the original ground surface to a maximum depth of c. 60 inches (Fig. 5.21 and Table 5.9).

Fewer than ten per cent of the bone fragments were larger than 50 mm, 60–80 per cent of them being 20–50 mm in length. Many of the fragments larger than 50 mm were either splinters of large mammal (mainly ungulate) long bones or the tubular midshafts of intermediate mammal long bones. We would expect the latter to be more reduced than the former if post-depositional modification was the dominant factor causing bone fragmentation, suggesting that the disparity in bone fragmentation reflects the deliberate breakage of ungulate bones to extract marrow. This

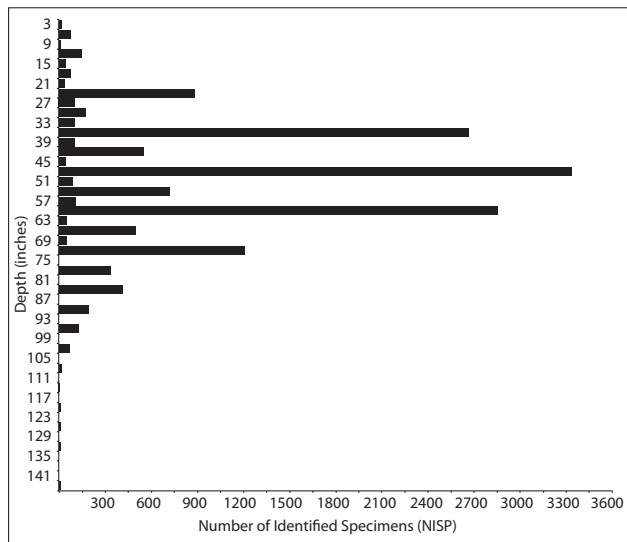


Figure 5.21. Distribution in Area A of fauna by depth from Harrison spits assigned to c. 35,000–11,500 BP. Most spits were 6 inches or 12 inches thick, a few were 3 inches thick. The excavation strategy resulted in low numbers of bones being recorded at intervals between the 6-inch and 12-inch spits, for example at 39 inches and 45 inches in depth. (Data compiled by Philip Piper and Ryan Rabett; illustration: Christopher Stimpson.)

Table 5.9. The total number of fragments (TNF) of bone recovered from the Harrison excavations in Area A of the West Mouth, Niah Great Cave. See Figure 5.23 for their distribution. The Late Pleistocene fauna discussed in this chapter were primarily at 48–60 inches in depth. (Data compiled by Philip Piper and Ryan Rabett.) **WHAT IS THE DIFFERENCE BETWEEN '0', a blank box and '/'? ADD TOTALS?- DORA**

Depth (inches)	Harrison trench						
	Y4	Y3	W5	W3	W4	W/X1	W/X2
6	0	20	/	1	/	/	/
12	1	13	6	7	2	20	/
18	0	26	/	1	/	/	/
24	0	9	19	22	2	11	23
30	0	40	/	/	/	/	/
36	2	10	19	2	29	200	119
42	214	45	/	/	/	/	/
48	392	306	131	277	127	262	34
54	103	400	/	/	/	/	/
60	1	146	679	232	110	69	1
66		136	/	/	/	/	/
72		50	145	36	30	38	6
78			/	/	/	/	
84			1	138	1	0	
90			/	36	/	6	
96			0	1	/		
102			/	1	/		
108			1		1		

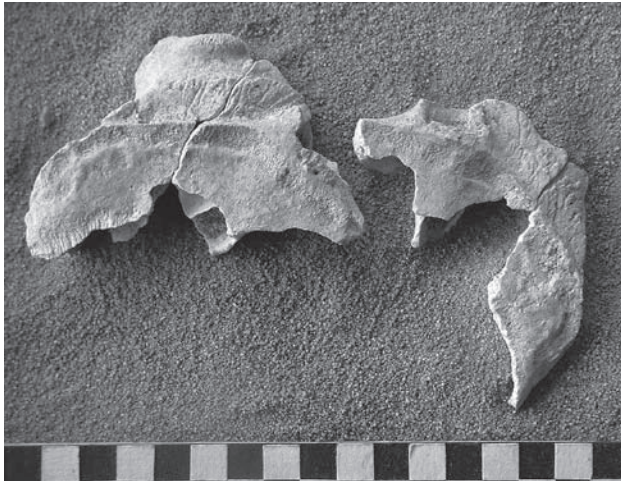


Figure 5.22. Re-fitted bone fragments from the squamous part of the temporal bone of *Sus sp.*, suggesting that the back of the skull had been smashed open to access the brain. Fragments from trench Y4 54–60 inches (HWM-14833). Scale: 5 mm increments. (Photograph: Ryan Rabett.)

hypothesis is supported by spiral fractures and impact scars on the cortical bone surfaces of some ungulate long bone fragments. Most bone fractures were transverse, longitudinal, or columnar in form, often with slightly weathered and abraded fracture surfaces (see Marshall 1989). These types of fracture are normally linked to dry old bone rather than to fresh ‘green’ bone (Johnson 1985). In some cases, a number of bone fragments from the same Harrison trench and the same or adjacent spits could be rejoined, implying that at least some of the bones had suffered only limited redistribution and re-working after discard and burial. A few re-fitting bones demonstrated fracture characteristics, impact scars, and negative flake scars distinctive of deliberate human breakage (Fig. 5.22). Very few fragments were burnt, in contrast with the bones associated with the first phase of human occupation in the West Mouth, but the incidence of cut marks also makes it clear that the primary accumulator of the Area A faunal material was people.

Between 40 and 60 per cent of the bone fragments demonstrate a slight rounding of their articular margins and fracture edges (see criteria in Rabett *et al.* 2006), and have randomly-orientated deep surface scratching and pitting. These types of modification are commonly associated with mechanical abrasion from activities such as trampling (Behrensmeyer *et al.* 1986; Lyman 1994, 380–84; Olsen & Shipman 1988). Another common surface feature of the assemblage was deep cracking of the cortical bone along the

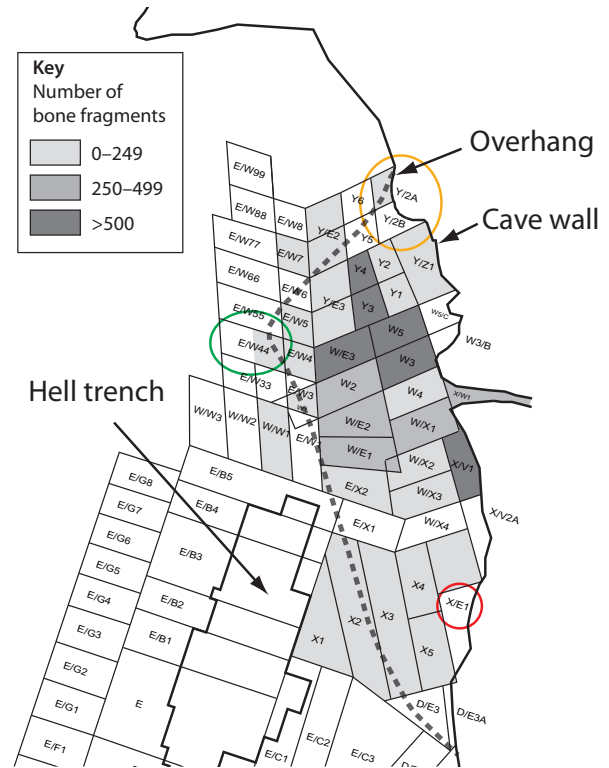


Figure 5.23. Bone-fragment distribution at maximum depth (60–48 inches) within the Harrison trenches in Area A. (Compiled by Philip Piper and Ryan Rabett; illustration: Lindsay Lloyd-Smith and Dora Kemp.)

Lindsay’s plan has Y/2A upper right not Y/2B (see orange circle). Lindsay’s plan has X/E1 one space south of yours (see red circle). Lindsay’s E/W44 is twice as big as yours (see green circle) What is correct? - DORA

main axis, associated with surface flaking, erosion of fracture margins, and exfoliation, modifications generally indicative of weathering caused by extreme changes in moisture content from alternating episodes of saturation and desiccation (Behrensmeyer 1978). In some cases the observed modification had affected the bone differentially, causing moderate or severe damage to one surface of a fragment but leaving the opposing surface either less affected or undamaged, implying that some bones had lain undisturbed for long periods on the surface before being buried. These data support the conclusions of Medway (1958a) that the area in and around the rock overhang was a location for refuse deposition and accumulation rather than a primary zone of occupation. The majority of bone refuse accumulated in the central area beneath the overhang (Fig. 5.23).

The bone fragments in the Late Pleistocene sample from Area A comprised, in terms of NISP

Table 5.10. Birds, mammals, and reptiles represented in the Late Pleistocene deposits from West Mouth (Areas A and B) and Lobang Hangus, Niah Great Cave. (Data compiled by Philip Piper and Ryan Rabett; * identifications by Medway 1958a and 1966.)

Class	Order	Family	Taxon	Common name	Area A (Early Phase II)		Area B (T/D)		Lobang Hangus				
					60–51 inches		>24 inches		54–60 inches (Phase I)		18–48 inches (Phase II)		
					NISP	%	NISP	%	NISP	%	NISP	%	
Reptilia	Testudines	Geoemydidae	Contains <i>Cyclemys/Heosemys</i>	Spiny hill/Asian leaf turtle	-	-	-	-	-	-	14	0.42	
			<i>Cyclemys dentata</i>	Asian leaf turtle	3	0.47	-	-	-	-	18	0.54	
			<i>Heosemys spinosa</i>	Spiny hill turtle	2	0.31	-	-	-	-	8	0.24	
			<i>Notochelys platynota</i>	Malayan flat-shelled turtle	5	0.78	1	0.44	-	-	28	0.85	
			Geoemydidae spp.	Hard-shelled turtle	101	15.83	7	3.06	1	1.96	297	8.98	
		Testudinidae	<i>Manouria emys</i>	Asian brown tortoise	-	-	1	0.44	-	-	1	0.03	
		Trionychidae	<i>Amyda cartilaginea/ Pelochelys cantorii</i>	Asian soft-shelled turtle/ Giant soft-shelled turtle	-	-	-	-	-	-	-	5	0.15
			<i>Amyda cartilaginea</i>	Asian soft-shelled turtle	3	0.47	1	0.44	-	-	7	0.21	
			<i>Dogania subplana</i>	Malayan soft-shelled turtle	2	0.31	1	0.44	-	-	4	0.12	
	Trionychidae spp.		Soft-shelled turtle	15	2.35	-	-	-	-	29	0.88		
	Squamata	Pythonidae	<i>Python</i> sp(p).	Reticulated or Borneo blood python	7	1.10	-	-	-	-	32	0.97	
Varanidae		<i>Varanus</i> spp.	Monitor lizard	37	5.80	20	8.73	6	11.76	404	12.22		
Crocodylia	Crocodylidae	<i>Crocodylus</i> cf. <i>porosus</i>	Estuarine crocodile	-	-	-	-	-	-	1	0.03		
Aves	Anseriformes	Anatidae	<i>Anatidae</i> sp.	Duck	-	-	-	-	-	-	1	0.03	
			<i>Anser</i> sp.	Goose	-	-	-	-	-	-	1	0.03	
	Galliformes	Phasianidae	Phasianidae spp.	Wild fowl/Pheasant?	3	0.47	-	-	-	-	4	0.12	
	Falconiformes	Accipitridae	<i>Macheiramphus alcinus</i>	Bathawk	2	0.31	-	-	-	-	2	0.06	
			<i>Haliastur indus</i>	Brahminy kite	-	-	-	-	-	-	2	0.06	
			cf. <i>Accipiter trivirgatus</i>	Crested goshawk	-	-	-	-	-	-	1	0.03	
			cf. <i>Ictinaetus malayensis</i>	Black eagle	-	-	-	-	-	-	2	0.06	
			<i>Spizeatus</i> sp.	Changeable hawk-eagle	-	-	-	-	-	-	1	0.03	
			Accipitridae sp.	Hawk	8	1.25	-	-	-	-	2	0.06	
	Strigiformes	Strigidae	<i>Ketupa ketupa</i>	Buffy fish owl	-	-	-	-	-	-	3	0.09	
			<i>Bubo sumatranus</i>	Barred eagle owl	-	-	-	-	-	-	0	0.00	
			<i>Strix leptogrammica</i>	Brown wood owl	-	-	-	-	-	-	1	0.03	
			Strigidae spp.	Owl	-	-	-	-	-	-	4	0.12	
	Coraciiformes	Bucerotidae	<i>Anthracoceros coronatus</i>	Pied hornbill	-	-	-	-	-	-	2	0.06	
			cf. <i>Anthracoceros malayanus</i>	Black hornbill	-	-	-	-	-	-	4	0.12	
			<i>Buceros</i> cf. <i>rhinoceros</i>	Rhinoceros hornbill	1	0.16	-	-	1	1.96	5	0.15	
			<i>Anorrhinus galeritus</i>	Bushy-crested hornbill	-	-	-	-	-	-	1	0.03	
<i>Rhyticeros corrugatus</i>			Wrinkled hornbill	-	-	-	-	-	-	2	0.06		
Bucerotidae spp.	Hornbill sp.	4	0.63	-	-	-	-	10	0.30				
Mammalia	Scandentia	Tupaiaidae	<i>Tupaia</i> sp.*	Tree shrew	-	-	-	-	-	-	1	0.03	
	Primates	Cercopithecoidea	<i>Macaca fascicularis</i>	Long-tailed macaque	6	0.94	-	-	2	3.92	59	1.78	
			<i>Macaca nemestrina</i>	Pig-tailed macaque	1	0.16	-	-	-	-	1	0.03	
			<i>Macaca</i> spp.	Macaque sp.	3	0.47	-	-	1	1.96	46	1.39	
			<i>Presbytis (presbytis)</i> spp.	Leaf monkey (not silvered langur)	4	0.63	-	-	-	-	21	0.64	
			<i>Presbytis</i> spp.	Leaf monkey	3	0.47	-	-	2	3.92	71	2.15	
			<i>Presbytis cristata</i>	Silvered langur	1	0.16	-	-	-	-	7	0.21	
			Cercopithecoidea spp.	Monkey	55	8.62	8	3.49	5	9.80	532	16.09	
		Hylobatidae	<i>Hylobates</i> cf. <i>muelleri</i>	Gibbon	1	0.16	-	-	-	-	4	0.12	
	Ponginae	<i>Pongo pygmaeus</i>	Orangutan	27	4.23	-	-	4	7.84	128	3.87		
	Hominin	<i>Homo sapiens</i>	Human	5	0.78	74	32.31	1	1.96	17	0.51		
	Pholidota	Manidae	<i>Manis javanica</i>	Pangolin	3	0.47	3	1.31	-	-	10	0.30	
	Rodentia	Sciuridae	Petauristinae spp.	Flying Squirrel	-	-	-	-	2	3.92	3	0.09	
<i>Ratufa affinis</i>			Giant squirrel	1	0.16	-	-	2	3.92	10	0.30		
<i>Callosciurus</i> sp(p).*			Tree squirrels	-	-	-	-	-	-	3	0.09		

**SUN BEAR HAS NO BONE FRAGMENTS BUT
HAS AN ASTERISK - IS THIS CORRECT OR CAN
I DELETE SUN BEAR FROM THE TABLE? - DORA**

Table 5.10. (cont.)

Class	Order	Family	Taxon	Common name	Area A (Early Phase II)		Area B (T/D)		Lobang Hangus					
					60–51 inches		>24 inches		54–60 inches (Phase I)		18–48 inches (Phase II)			
					NISP	%	NISP	%	NISP	%	NISP	%		
Mammalia	Rodentia	Sciuridae	Sciuridae spp.	Squirrel	2	0.31	-	-	4	7.84	49	1.48		
		Hystricidae	<i>Hystrix brachyura/ Thecurus crassipinis</i>	Common porcupine	-	-	-	-	-	-	2	0.06		
			<i>Trichys fasciculata*</i>	Long-tailed porcupine	-	-	-	-	-	-	1	0.03		
			Hystricidae spp.	Porcupine	4	0.63	-	-	-	-	10	0.30		
	Carnivora	Ursidae	<i>Helarctos malayanus*</i>		Sun bear	-	-	-	-	-	-	-	-	
		Mustelidae	<i>Aonyx cinerea</i>		Oriental small-clawed otter	-	-	-	-	-	-	3	0.09	
			<i>Martes flavigula</i>		Yellow-throated martin	1	0.16	-	-	-	-	1	0.03	
			Mustelidae spp.		Mustelid sp.	1	0.16	-	-	-	-	2	0.06	
		Viverridae	<i>Viverra zangalunga</i>		Malay civet	1	0.16	-	-	-	-	2	0.06	
			<i>Paradoxurus hermaphroditus</i>		Common palm civet	2	0.31	-	-	-	-	1	0.03	
			<i>Paguma larvata</i>		Masked palm civet	1	0.16	-	-	-	-	7	0.21	
			<i>Arctictis binturong</i>		Bear cat	4	0.63	-	-	1	1.96	133	4.02	
			<i>Arctogalidia trivirgata</i>		Small-toothed palm civet	-	-	-	-	-	-	1	0.03	
			<i>Hemigalus</i> sp.		Banded or Hose's civet	-	-	-	-	-	-	2	0.06	
			<i>Herpestes</i> sp.		Mongoose	-	-	-	-	-	-	2	0.06	
			Viverridae spp.		Civet cat	7	1.10	-	-	-	-	91	2.75	
			Felidae	<i>Felis badia</i>		Bay cat	1	0.16	-	-	-	-	-	-
				<i>Felis</i> cf. <i>planiceps</i>		Flat-headed cat	-	-	-	-	-	-	1	0.03
		<i>Prionailurus bengalensis</i>			Leopard cat	-	-	-	-	-	-	9	0.27	
		<i>Felis/Prionailurus</i> sp(p).			Cat	3	0.47	2	0.87	2	3.92	34	1.03	
		<i>Neofelis diardi*</i>			Clouded leopard	-	-	-	-	-	-	1	0.03	
		Perissodactyla	Rhinocerotidae	<i>Dicerorhinus sumatrensis*</i>		Sumatran rhinoceros	1	0.16	-	-	-	-	2	0.06
		Artiodactyla	Suidae	<i>Sus</i> cf. <i>barbatus</i>		Bearded pig	293	45.92	110	48.03	15	29.41	1095	33.11
			Tragulidae	<i>Tragulus napu</i>		Greater mousedeer	2	0.31	-	-	2	3.92	14	0.42
	<i>Tragulus</i> sp(p).				Mouse deer	-	-	-	-	-	-	13	0.39	
	Cervidae		<i>Muntiacus</i> cf. <i>muntjac</i>		Common muntjak	1	0.16	1	0.44	-	-	11	0.33	
	<i>Cervus unicolor</i>			Sambar	5	0.78	-	-	-	-	5	0.15		
Bovidae	<i>Bos</i> cf. <i>javanicus</i>		Banteng	6	0.94	-	-	-	-	4	0.12			
Total (NISP and %)					638	100	229	100	51	100	3305	100		

(Numbers of Identified Specimens): 440 (69.5 per cent) mammal (excluding bats and five human bones), 175 (27.6 per cent) reptile, and eighteen (2.8 per cent) bird (excluding swiftlets) (Table 5.10). The sample included fourteen families of mammals (nineteen identified to genera or higher taxonomic classification), at least four families of reptiles (nine identified to genus or higher) and three families of large birds (five identified to genus or higher). The coarse methods of excavation employed in the 1950s and 1960s investigations of the deposits under the overhang will have inevitably influenced the numbers of elements of smaller taxa recovered and we might expect a bias in favour of the elements of larger animals. The fact that most bone fragments are small suggests that recovery was in fact rather conscientious, though certain taxa are probably under-represented in the analysis of species representation and abundance.

Pig, almost certainly the bearded pig (*Sus barbatus*: see Cucchi *et al.* 2009), is by far the most common mammal in the Late Pleistocene assemblages, accounting for 46.4 per cent ($n = 293$) of the bones identified to family or higher and 96 per cent of the larger bodied mammals, a group that also includes animals such as the bovids and sambar deer (*Cervus unicolor*). Even though some axial and appendicular elements not identified to a specific taxon might be attributable to other larger bodied mammals, it is highly likely that they almost all derive from pigs. All axial and appendicular elements of pig are represented in the assemblage (Volume 2, Chapter 20), suggesting that whole carcasses were being transported back to the West Mouth. An unfused left distal humerus, two lower left second molars without root development (unerupted) and one with no visible occlusal wear indicate that this assemblage included at least three individuals

under a year old at the time of death. A fragment of a left upper maxilla with a fully erupted and unworn second molar and an erupting third molar suggest an individual between one and two years old. Six lower left third molars with a variety of wear stages from unworn to extremely worn indicating the presence of adult pigs from young adult to old. These few data do not provide a clear indication of the possible strategies employed by the Late Pleistocene hunters to hunt pigs, but the mix of adults, sub-adults and juveniles is the same as in the initial phase of occupation in the West Mouth (Chapter 4), hinting at an unselective hunting method being used such as trapping. Placing snares along known animal trails is the least specialized of trapping approaches in terms of the taxa, age, and sex of the animals taken (Lupo & Schmitt 2002 **NOT IN REFS**; O'Brian & Kinnaird 2000 **NOT IN REFS**), selective only in terms of animal size and weight (Noss 1998 **NOT IN REFS**).

All three genera of deer that currently inhabit Borneo (Fig. 4.18) are also represented, namely sambar deer, common barking deer and greater mouse deer, but none is common. Similarly a few fragments ($n = 15$) of large bovine, probably the native banteng (*Bos* cf. *javanicus*) were distributed throughout Area A. The Late Pleistocene sample also includes a single tarsal of the Asian two-horned rhinoceros (*Dicerorhinus sumatrensis*). There were several fragments of porcupine, but the size of the fragments makes it difficult to identify them to any one of the three modern species in Borneo. Primates comprise *c.* 15.9 per cent ($n = 101$) of the assemblage, the most common single species represented being the orangutan ($n = 27$). However, the orangutan remains are heavily outnumbered by monkey remains ($n = 73$) when all those specimens that can only be identified to the Family Cercopithecidae are taken into consideration. The most common are langurs and long-tailed macaques, which are represented in almost equal proportions. There was also a single specimen of gibbon (*Hylobates* cf. *muelleri*), which like the orangutan is an animal of close-canopy forest. Tooth eruption and epiphyseal fusion data indicate that most of the primates caught were adult, the wear on the permanent molars suggesting that young mature adults slightly outnumber older individuals. The assemblage is represented by bones from all parts of the body, with little difference in the numbers of hind limbs compared to fore limbs. Under-representation of the lower appendicular elements is probably a result of recovery bias rather than real variation in the presence of anatomical elements.

Carnivore bones ($n = 29$) make up 3.4 per cent of the assemblage identified to taxon. Four of the most common species of viverrid in Borneo today are all

represented: common palm civet, masked palm civet, Malay civet and binturong. Several skeletal elements of wild cat (*Felis/Prionailurus* sp.) were found in the Late Pleistocene assemblage from Area A, and also one fragment tentatively identified as bay cat (*Felis badia*). Minor species represented include two mustelids (one identified as the yellow-throated marten, *Martes flavigula*). Small mammals are also rare: three fragments of bone were attributed to squirrel, including one to the giant squirrel (*Ratufa affinis*). In addition to the taxa identified in the present study, Medway (1958a) reported the Malay weasel (*Mustela nudipes*) in trench W/E3 at 48–60 inches and the leopard cat (*Felis* [= *Prionailurus*] *bengalensis*) in W2 at 60–72 inches.

Of the total of 175 reptile bones recorded in the Late Pleistocene bone assemblage, the only snake species identified so far is the reticulated python (*Python reticulatus*); the bones of other large snakes are rare in the assemblage. The most frequently occurring taxa are monitor lizards (*Varanus* sp(p).) and three species of locally-common hard-shelled turtles: Asian leaf turtle (*Cyclemys dentata*), Malayan flat-shelled turtle (*Notochelys platynota*), and spiny hill turtle (*Heosemys spinosa*) (see Pritchard *et al.* 2009). Carapace fragments of the Asian soft-shelled turtle (*Amyda cartilaginea*) occurred in small numbers throughout the deposits under the rock overhang, along with the remains of the Malaysian soft-shelled turtle (*Dogania subplana*). The Asian soft-shelled turtle prefers various types of freshwater habitat, such as muddy rivers and ponds, spending most of its time buried in soft mud or sand, with activity restricted to dusk and dawn (Liat & Das 1999, 38–40). It is generally caught using a baited hook and line, though another technique is to wade through the river stabbing a barbed harpoon into the mud to penetrate its leathery carapace (Peter Pritchard pers. comm.). The Malayan flat-shelled turtle, spiny hill turtle and Asian leaf turtle are all terrestrial/aquatic common species that inhabit shallow waters, swamps, ponds and streams and could probably have been obtained locally (Liat & Das 1999). Medway (1958a) reported that these species could be encountered whilst tracking through the forest, or caught in nets whilst fishing or dug from their holes in muddy river banks.

Two species of bird were identified: the bathhawk (*Macheiramphus alcinus*) and the rhinoceros hornbill (*Buceros rhinoceros*). Three specimens of Phasianidae were also recorded in the assemblage. Today the biogeographic distribution of the red jungle fowl (*Gallus gallus*) extends from northeast Indian and southern China south to Malaysia and Sumatra, and that of the green jungle fowl (*Gallus varius*) is located in Java, Bali, Lombok and Flores. It is more likely that the Niah specimens belong to native pheasant species.

Table 5.11. The effects of biased recovery of fauna from Area B in the West Mouth. The table lists the Total Number of Fragments (TNF) retained by spit from the 1959 T/D and E/D1 (A and B) and 1965 E/D2–E/D8 excavations. Note that bones are recorded by 3-inch spit from the 1959 excavations and by 1-inch spits in 1965. The effect of discard is also discernible from the number of fragments recovered from around the supposed hearth in E/D3 at a depth of 48–60 inches. (Data compiled by Philip Piper and Ryan Rabett.) **WHAT IS THE DIFFERENCE BETWEEN \ AND A BLANK CELL? - DORA**

Max. depth (inches)	T/D1	T/D2	T/D3	E/D1	E/D1(A)	E/D1(B)	E/D2	E/D3	E/D4	E/D5	E/D6	E/D7	E/D8
12				1	172	480			11	57	7	6	10
15	14	92	4										
17	\	17	\										
18	43	44	6										
21	27	16	2										
24	21	29	\	8			30	26	3	21	2	24	27
27	19	\	17										
30	24	19	10										
33	21	41	38										
36	18	66	16	11			11	12	8	8	3	20	24
39	30	2	12										
42	31	25	23										
45	21	37	23										
48	34	40	47	4			18	8	2	10	4	9	10
51	\	44	22										
54	61	68	16										
57	16	21											
60	18	6		1			17	211			3	1	6
63	25	10											
66	18	5											
69	16	1											
72	7	4					3	8				8	3
75	1												
78			1										
84								3					
Grand total (by trench)	465	587	237	25	172	480	79	268	24	96	19	68	80

It has been possible only to conduct a preliminary study of the Niah fish remains, but two taxa are certainly represented within the Area A Late Pleistocene assemblage: catfish and carp. Most of the fish identified appear to be freshwater species, some probably with a brackish tolerance, including the bottom-dwelling catfish and neritic cyprinids. The size of the largest specimens indicates that fish were probably being sought from the large rivers and lagoons predicted earlier to have occurred north of Niah (Fig. 5.4), rather than streams. Traditional methods of fishing in Borneo today are very diverse, but T. Harrison (1950 **NOT IN REFS**) classified them into ten main categories: small bamboo traps, large bamboo traps, weirs, stone dams, poison, hand nets, throw nets, hook and line, spears and ponds. It is impossible to say which if any of these methods were used by the people who camped in the West Mouth in the Late Pleistocene, but certainly much of the apparatus used for traditional methods of fishing is still commonly made of locally-available materials.

Area B

Unfortunately in 1965, when the E/D series of trenches was dug, the Sarawak Museum team had logistical problems with the transportation of archaeological materials from Niah back to Kuching. To limit the quantity of artefacts to be transported, Harrison opted to select those bones he considered to be identifiable by Lord Medway, and to discard the rest. (This was presumably done at the Pankalan Lobang base camp by the Niah River.) Table 5.11 demonstrates how this process has biased the assemblage: compare the numbers of vertebrate remains recorded in the small T/D trenches and in Trenches E/D1(A) and E/D1(B) in 1961 with those from Trenches E/D1–E/D8 in 1965. Harrison also kept all the bone fragments from around what he tentatively identified as an *in situ* hearth in E/D3 between 48 and 60 inches. Although there are no burnt or calcined bones to support the latter interpretation, the substantially greater number of bones retained demonstrates how much material must have been discarded from other spits in this and

other trenches. It is also clear from the new study of the faunal material deriving from Area B that even this 'intact' assemblage probably contains a large proportion of bone fragments that have been re-worked and/or re-deposited, especially from the digging of graves in this part of the cave entrance: the bones are composed of a variety of colours, the taphonomic condition is highly variable, and bones were distributed ubiquitously through the spits.

These observations correspond well with Medway's (1958a) discussion of the animal bones recovered from the 1957 and 1958 excavations. He reported that there were no significant concentrations of bones anywhere in the 'occupation zone', no spit with a significantly higher concentration of bones throughout the sequence, nor any true midden deposits. However, he did note that some accumulations of bones were associated with 'definite hearth rings', suggesting discrete activity areas (Medway 1958a, 629). He also suggested that bones were scarcer towards the front of the cave and under the rock shelter, possibly as a result of poor preservation, but also because these regions of the West Mouth were outside the main activity areas of the occupation zone. His conclusions were confirmed by our own studies of spatial distributions and taphonomy (Volume 2, Chapter 20).

The imprecise methods of excavation and potential re-working of the vertebrate remains in the T/D trenches pre-dating the Neolithic horizons limit any detailed zooarchaeological interpretation. Consequently the faunal assemblages from this part of the cave can only be described in general terms (Table 5.10). Of the 974 bone fragments recorded (as calculated from below 24 inches from the 1950s ground level) in trenches T/D and E/D, 954 were almost certainly mammal, 34 were reptile, and two were identified as bird. In total, 229 fragments could be identified to family or to a higher taxonomic level, of which 74 were pieces of human skeleton, mostly small cremated fragments. The low proportions of skeletal elements identifiable to particular taxa were a result of the large numbers of small fragments of bone within the assemblage. Most identifiable bones were either cranial fragments or small compact extremities: of the 110 pig bones recorded in the T/D trenches, for example, 92 (83.6 per cent) were either cranial fragments or bones of the feet. The prevalence of extremities, cranial and mandibular fragments and loose teeth is fairly typical of the bone assemblages from Niah, the possible reasons for which are discussed in Volume 2, Chapter 20. Other mammal taxa present in the assemblage were the long-tailed macaque (*Macaca fascicularis*), muntjac (*Muntiacus* spp.), mouse deer (*Tragulus* spp.) and pangolin (*Manis javanica*), together

with a few indeterminate bones of one or more felids and viverrids. Reptiles were also well-represented, constituting 13.5 per cent ($n = 31$) of the identified assemblage. The most abundant remains are those of the monitor lizard and hard-shelled turtle, the only identifiable taxon being the Malayan flat-shelled turtle. Also represented by a small number of fragments are the Asian soft-shelled turtle, the Malayan soft-shelled turtle, and the Asian brown tortoise (*Manouria emys*).

Lobang Hangus

The re-analysis of the vertebrate fauna from this entrance concentrated on the 1959 assemblage because Tom Harrisson selectively discarded many of the bones excavated in 1965 (Fig. 5.24). The distribution of the fauna in these trenches (Table 5.12) indicates that the Late Pleistocene assemblage tended to concentrate in a single 6-inch spit towards the entrance to the cave (trenches US/10 and US/14), its distribution thickening further into the interior (trenches US/18 and US/22). Along with the evidence we found in our test pits of dumps of bones beyond the main occupation area investigated in the Harrisson excavations, the distributions suggest a deliberate attempt to keep occupation refuse away from the front of the cave, rather like the use of Area A as a defined area for dumping refuse by the people using the West Mouth. Within the main zone of refuse were two concentrations, one at 12–24 inches in trenches US/14, US/15 and US/18 and the other further back into the cave at 24–30 inches in trenches US/22 and US/26, each with an apparent 'toss-zone' of material around them.

[Fig. 5.24 and Table 5.12 about here].

The vertebrate faunal sample consisted of just under 10,000 fragments, of which 3356 were identifiable to family or higher taxonomic classification from the two phases of activity during the Late Pleistocene: Phase I, dating to 32,660±210 bp or 36,583–38,059 BP (OxA-13938) ($n = 51$) and Phase II, containing the bulk of the assemblage ($n = 3305$), dating to between 12,500±50 bp or 14,206–15,061 BP (OxA-13936) and 10,450±45 bp or 12,135–12,550 BP (OxA-13939) (Table 5.10). Although the list of taxa represented is much as in the West Mouth material, with the same dominance of pig bones by NISP, when values of MNE and MNI are re-calculated taking into consideration only those bones identifiable in both pig and monkeys (following Lyman 2009), the frequencies of occurrence are reversed and the latter slightly outnumber the former (Piper & Rabett 2009c). The Lobang Hangus assemblage also differs from that of the West Mouth in its marked predominance of taxa adapted to arboreal

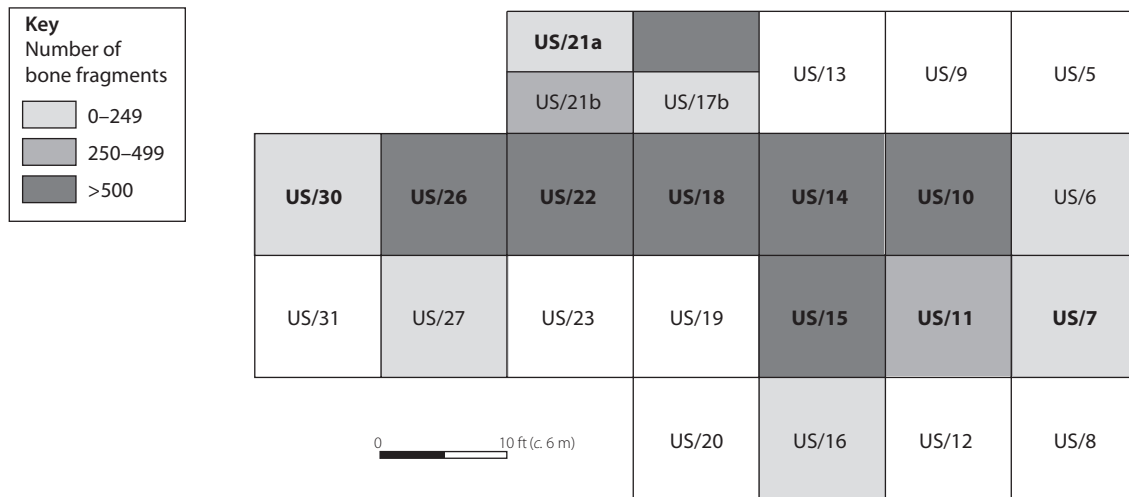


Figure 5.24. The Harrison trenches at Lobang Hangu showing bone-fragment distribution: trench numbers in bold text indicate trenches excavated in 1959, the fauna of which was re-studied by the NCP; the 1965 material was not studied as Tom Harrison selectively discarded much of it. See Table 5.12 for the densities of faunal material in the 1959 trenches. See Figure 3.33 for a site plan of Lobang Hangu. (Data compiled by Philip Piper and Ryan Rabett; illustration: Dora Kemp.)

Table 5.12. The total number of fragments (TNF) of bone recovered from each 6-inch spit excavated at Lobang Hangu in 1959. The values correlate with the bone weights published by Medway (1966 NOT IN REFS 1966a??). See Figure 5.24 for their distribution. (Data compiled by Philip Piper and Ryan Rabett.) **I HAD TO CORRECT TOTAL OF COLUMN US/18 - DORA**

Spit depth (inches)	Harrison trench										
	US/7	US/10	US/11	US/14	US/15	US/17a	US/18	US/21a	US/22	US/26	US/30
6	29	4	29	4	26	50		22	2	4	4
12	39	130	42	27	79	83	30	26	8	63	11
18	6	1112	248	97	328	142	80	122	15	154	20
24	2	92	222	610	294	84	338	114	108	388	103
30		12		105	74	155	233	55	244	546	
36				13	18	179	345	53	496	758	
42						286	88	35	337	300	
48						264	89	47	116	1	
54						13	15	62	54		
60						16		1	12		
Total	76	1350	541	856	819	1272	1218	537	1392	2214	138

and arboreal/terrestrial habitats. These included cats and civets, though monkeys (Cercopithecidae) were the most common prey (Fig. 5.25). On the evidence of their present-day behaviour, macaques and leaf monkeys were probably caught most easily of these fauna, as they venture closer to the ground and live at greater population densities than orangutans or gibbons. The calculation of ages at death from tooth eruption and wear and epiphyseal fusion revealed a higher than expected frequency of adult (especially young adult) macaques and leaf monkeys compared with modern hunted populations, as well as juvenile animals under two years old, perhaps young clinging to their mothers when the latter were killed. Pigs were the second major category of game, with juvenile,

sub-adult, and adult animals all represented, as in the West Mouth assemblages. The data suggest that people used Lobang Hangu in the Late Pleistocene as a base not only for hunting pigs on an encounter basis but also for hunting macaques and leaf-monkeys, targeting young adults especially.

One peculiarity of the pig remains is the disparity between the numbers of mandibles and maxillae (lower and upper jaws): a minimum number of seventeen individuals is represented by the upper second molars, compared with nine represented by lower first molars. There is no obvious taphonomic reason for this disparity in survival. Cranbrook and Labang (2003 NOT IN REFS) reported that the Penan hunters of the interior forests of Sarawak often hung pig

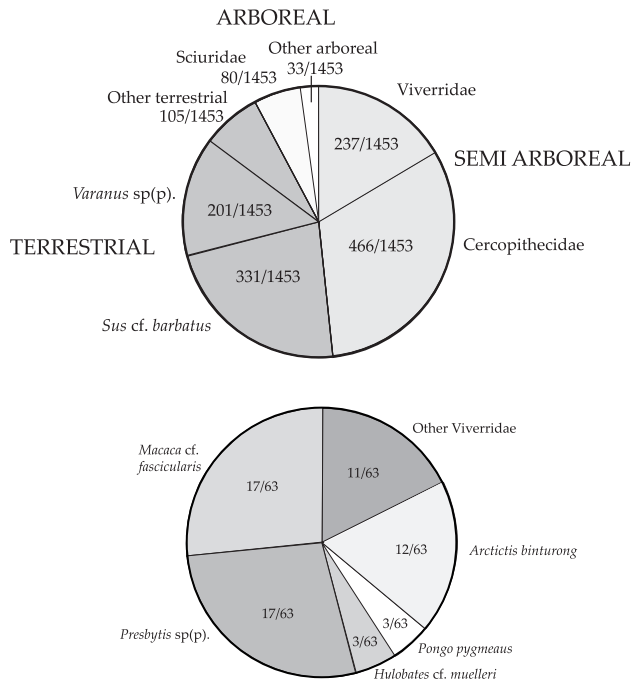


Figure 5.25. Lobang Hangus Late Pleistocene fauna: (above) proportions of terrestrial, arboreal and semi-arboreal taxa (turtles, reptiles and raptors excluded) according to the Number of Identifiable Specimens (NISP); (below) proportions of semi-arboreal and arboreal primates and viverrids according to the Minimum Number of Individuals (MNI). (Data compiled by Philip Piper and Ryan Rabett; illustration: Dora Kemp.)

mandibles as trophies from their camp structures or nearby trees. It is conceivable that this kind of trophy display of pig mandibles explains the low numbers of mandibles at Lobang Hangus.

Butchery techniques

In total, 100 bone fragments from the Late Pleistocene deposits in the West Mouth (Area A) and Lobang Hangus demonstrated cut, chop and/or scrape marks produced in the process of carcass dressing (Fig. 5.26). Recognition of the incisions as humanly made closely followed the criteria laid down by Potts and Shipman (1981 **NOT IN REFS**): they were located predominantly near articular surfaces, exhibit a 'V'-shaped profile, and have fine parallel striations along the walls of the cut and their locations can be linked to the severance of specific groups of muscles. The details of the methodologies, and the full data, are contained in Volume 2, Chapter 20.

In the case of the West Mouth material, cut marks occur repeatedly ($n = 14/15$) at the top of the femur: cut-zones Fp-1 and Fp-2 on Figure 5.27. Fp-1

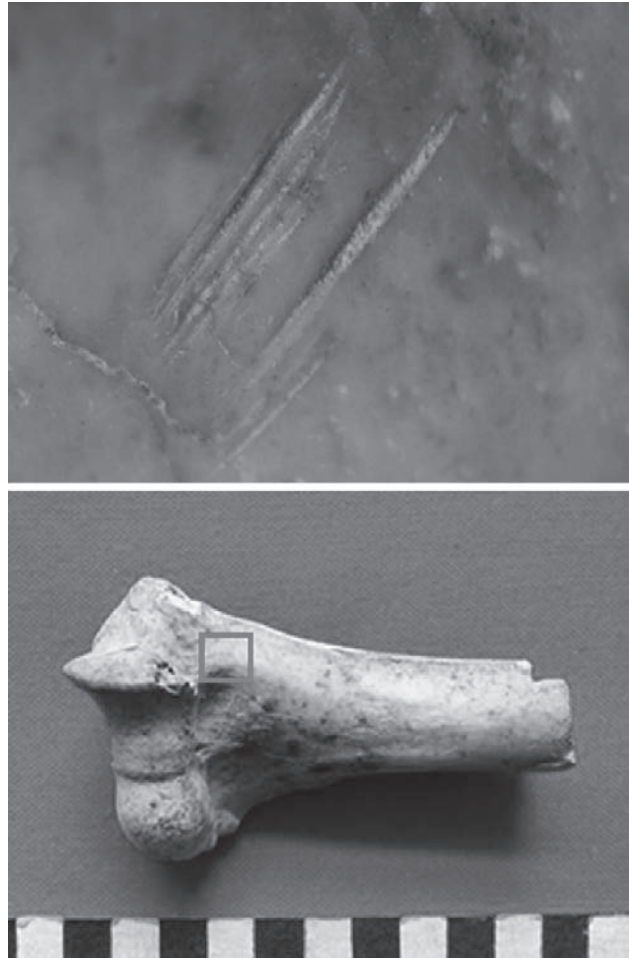


Figure 5.26. An example of a Late Pleistocene butchered or cut-marked bone at Lobang Hangus (trench US/22 42–48 inches): a left distal humerus of *Macaca* sp., with multiple transverse cut marks beneath the medial supracondylar crest (HLA-18496). Scale in 5 mm increments; magnification of cut marks $\times 30$. (Photograph: Ryan Rabett/)

probably relates to the insertion point of the muscle at the lesser trochanter, Fp-2 to the muscles that insert into the greater trochanter (Jarmey 2008). There is a single example of a cut mark at Fp-4, at the same part of the bone as the lesser trochanter but on the anterior surface, probably from severing the vastus medialis muscle close to its point of origin. The Lobang Hangus material has cut marks in the Fp-1 zone but not the Fp-2 zone, and cut marks in zones Fp-3, Fp-4, and Fp-5; the Fp-3 cuts, on the proximal posterior section of the femoral shaft, may result from severing the hamstring. The differences between the butchery techniques practised at the two sites indicate that there was greater variability in tissue removal, or cutting of more muscle groups, at Lobang Hangus.

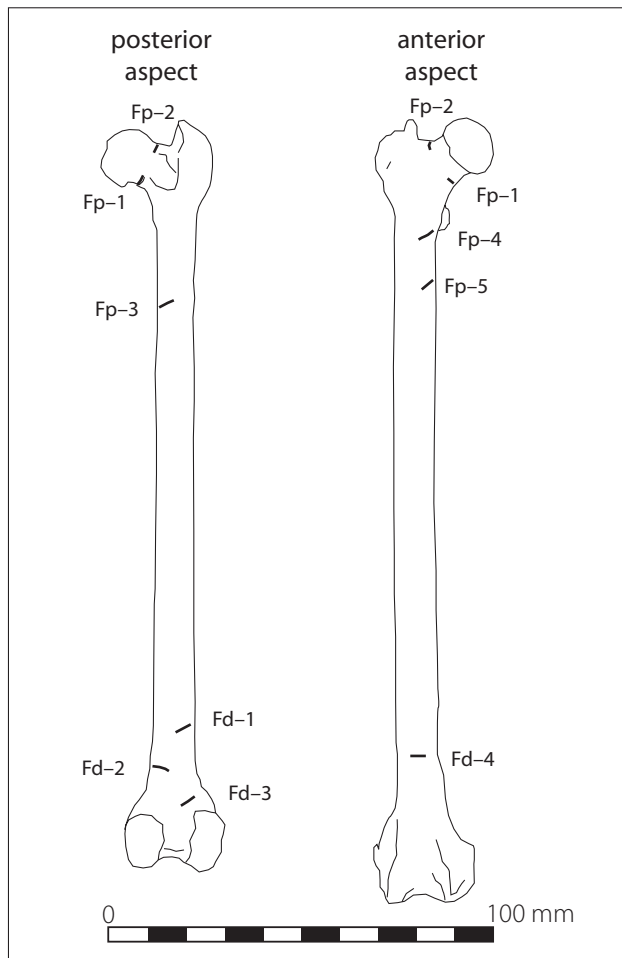


Figure 5.27. A stylized monkey femur, showing the location of identified cut zones. (The cut-mark recording system used is discussed in detail in Volume 2, Chapter 13.) Scales in 5 mm increments. (Drawing: Ryan Rabett and Christopher Stimpson.)

Modifications were observed on a range of different skeletal elements and in the bones of animals ranging in size from deer and cattle to cats and squirrels. The skeletal elements of intermediate-sized mammals, in particular primates, displayed the highest frequency of cut marks, with multiple fine incisions indicating the systematic disarticulation of the carcass through the careful severing of muscles and tendons. Multiple transverse cut marks at the distal end of the humerus or the proximal ends of the radius and ulna represent attempts to separate the upper and lower forelimb. This type of butchery is very prominent in the case of the binturong (*Arctictis binturong*), which has extremely strong forelimb muscles for climbing and grasping. Interestingly, butchery marks are scarce at the proximal end of the humerus or on the scapula, implying that the process of severing the muscles here

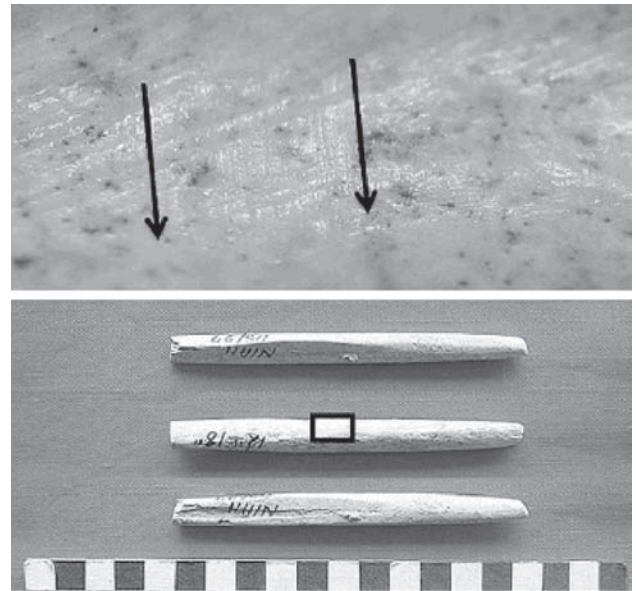


Figure 5.28. Late Pleistocene worked bone fragment from Lobang Hangu, probably a broken portion of a projectile point. The left half has been modified for hafting, and the middle (the boxed area in the central bone image, shown as 40× magnification in the top image) has transverse striations with binding wear. Scale in 5 mm increments. (Photographs: Ryan Rabett.)

rarely inflicted damage to the bone, or that a different technique of disarticulation was employed such as removal of the scapula and humerus as a single unit. In the case of monkeys, in particular, one reason for systematic butchery appears to have been for acquiring raw material to make tools (Rabett & Piper 2011). Several proximal ends of Cercopithecidae femora have evidence of a ‘groove and snap’ technique: a deep incision was made around the circumference of the bone so that the end could be broken off and discarded, leaving the long straight shaft of bone, sometimes with the distal articular end attached, for fashioning into an implement (e.g. Fig. 5.28).

These patterns in the butchery evidence suggest that the foragers at Niah were carefully and purposefully disarticulating a wide range of different-sized prey animals. Whilst considerable similarities in butchery practice can be observed across taxa, there are intriguing hints of differences in the *chaîne opératoire* or operational sequences of disarticulation practised in the West Mouth and Lobang Hangu. These might have been the result of the actions of different communities of people using distinct traditions of butchery. It is also possible that the hunting systems employed at Lobang Hangu incorporated a degree of deliberate targeting of species (and age groups within

species) to obtain raw material for tool production, as well as food provision.

Hunting systems and technologies [HB, PP, RR]

In its taxonomic composition, the Late Pleistocene vertebrate faunal assemblage from the West Mouth is remarkably similar to modern-day figures compiled for Penan hunters in Borneo. In a 21-month study of hunting (February 1991 to November 1992), Rajandra Puri (2005) recorded that the Penan Benalui of Long Peliran captured a total of 46 species: 28 species of mammal, eight of reptile, and ten of bird. The respective figures for the West Mouth assemblage are 26 (29 if the Medway identifications are included), eight, and twelve. In both the archaeological and ethnographic samples, the pig is the most heavily predated mammal, its remains comprising *c.* 45 per cent of the Late Pleistocene West Mouth assemblage and more than 90 per cent of the larger-bodied mammals, whereas the 707 bearded pigs killed in the Penan study represented 80 per cent of the total animals captured and 93 per cent of the ungulates. Ungulates represented 98 per cent of all the edible meat obtained by the Penan in Puri's study, and 60–90 per cent in another study of Sarawak Penan (Caldecott 1988 **NOT IN REFS**). In the Long Peliran case, carnivores contributed about three per cent of all captures, reptiles about 3.7 per cent of captures and 1 per cent of edible meat, and primates 1.5 per cent of captures and 0.2 per cent of edible meat. Many other species were taken in very low frequency, often during chance encounters while people were engaged on other tasks such as clearing rice fields or en-route to pursue larger game. The Lobang Hanguas assemblage is therefore particularly unusual in the high frequencies of monkeys and small carnivores along with pigs.

It is certainly unwise to transpose Penan hunting and the habitat characteristics of their lowland rainforests in present-day Borneo directly back to Late Pleistocene Niah. Also, the low temporal resolution and long timescale of the Late Pleistocene and Early Holocene faunal-bearing deposits in the West Mouth and Lobang Hanguas place limitations on interpreting hunting practices in particular phases. It seems likely, however, that the West Mouth and Lobang Hanguas middens represent accumulations of material that mirror the richness of game hunted successfully by the Penan today largely because they consist of cumulative assemblages created by repeated use of the cave entrances over a considerable period of time. It is also true that the similarities between what was hunted from the West Mouth and Lobang Hanguas in the Late Pleistocene and today from Long Peliran remain striking.

The assemblage at Long Peliran was captured using a wide range of techniques and technologies:

While many tools are clearly used in a variety of habitats and are thus transferable, techniques and tools together are less easily transferred between habitats. Within a particular habitat, then, tools and techniques are flexibly wielded for a number of potential prey. Thus a blowpipe, usually more successful with smaller animals due to the strength of the poison, is capable of taking a wide variety of arboreal animals, including birds, bats, primates, civets, and squirrels. *Jala* 'casting nets' are used to capture fish, turtles, lizards, birds, swimming pigs, and deer. *Ngaso* 'hunting with a dog' and a spear can be used to capture anything in shallow water, on the ground, or even at low elevation in trees, where cats, bears, or mongooses might be found. *Sa'ut* 'traps' are used to apprehend a variety of predators of cultivated areas. (Puri 2005, 187)

Whilst there is no evidence for the use of dogs to aid hunting in the Late Pleistocene, with domestic dogs only identified securely in the Metal Age at Niah (Chapter 8), the bow and arrow may have been used by the Niah hunters by the end of the Pleistocene (they were certainly being used in the Early Holocene: see Chapter 6, and Barton *et al.* 2009). Though direct evidence for the bow is lacking, inferences for the use of projectiles can be drawn not only from the wide variety of arboreal game captured (at Lobang Hanguas particularly) but also from the bone technology employed (Piper & Rabett 2009c; Rabett 2005). Numerous bone points were found in both the West Mouth and Lobang Hanguas deposits (Harrison & Medway 1962; Medway 1966a). Few of those from the West Mouth came from stratigraphically secure and dated contexts, and few of these were available for re-examination. However, there are 43 bone points from the deposits at Lobang Hanguas securely dated to the Late Pleistocene, between 12,500±50 bp or 14,206–15,061 cal. BP (OxA-13936) and 10,720±75 bp or 12,444–12,811 cal. BP (OxA-14038), fourteen of which have manufacturing and use-wear signatures consistent with those observed on experimental bone projectile tips (Volume 2, Chapter 16). They probably represent the tips of projectile points that had broken off in the animal, and fallen from the carcass during its butchery. One of the complete bone points has transverse striations consistent with it having been bound or hafted onto a shaft (Fig. 5.28).

The other technology that was very likely used was snares and traps. One indicator of this is the age range of the pigs brought back to the West Mouth and Lobang Hanguas. The other is the frequency at Lobang Hanguas of predominately nocturnal taxa in quite large numbers such as leopard cat, bear cat and

masked palm civet. Today hunters can surprise and kill animals in the rainforest by using powerful lamps to isolate and surprise game. Without such technologies, the easiest way to trap nocturnal animals would have been with devices such as noose snares and leg traps, a technology that, adapted for their greater weight, would also have been effective for catching terrestrial animals like pigs. The presence of omnivores and carnivores such as monitor lizards implies the use of baited traps.

Gathering molluscs [KS]

Molluscan remains dating to the phases of occupation discussed in this chapter were recovered from Areas A and B in the West Mouth, and from the basal levels of Lobang Hangu and Gan Kira. The molluscan material archived in Sarawak Museum is patchy, as Harrison discarded all of the shells from these levels of the West Mouth and Lobang Hangu (1965 **NOT IN REFS 1965b??**) excavations after on-site identification and quantification, and part of the 1959 Lobang Hangu shell assemblage was destroyed in a flood at the Niah Caves National Park branch of the Museum. The following discussion is therefore based on a combination of three lines of data: the on-site shell midden records; the re-analysis of extant midden in the Harrison Excavation Archive; and analysis of the small quantities of shells recovered from the NCP excavations. How the Harrison on-site shell records were interpreted is detailed in Volume 2 Chapter 21.

The shell assemblages relevant to this chapter are sandwiched between the earliest deposits (where present) discussed in Chapter 4, and the distinctive brackish-water molluscan assemblages associated with the flooding of the Sunda Shelf at the Pleistocene/Holocene boundary. This faunal turnover in local aquatic molluscan resources forms a distinct stratigraphic boundary separating Pleistocene and Holocene deposits except where disturbance, time-averaging, and the conflation of temporally-diverse materials as a result of spit-based excavations have resulted in irreconcilably mixed assemblages. The dramatic changes in the composition of molluscan assemblages are not recorded for other excavated materials such as animal bones and stone tools, so the detailed examination of their nature and structure gives a unique window on the stratigraphy and integrity of the Niah deposits. The details of the molluscan biostratigraphy are described in Volume 2 Chapter 21. Trenches with good stratigraphic resolution such as Y/E3 in Area A of the West Mouth and US/17a in Lobang Hangu reveal distinct differences in molluscan assemblages by depth. In the case of

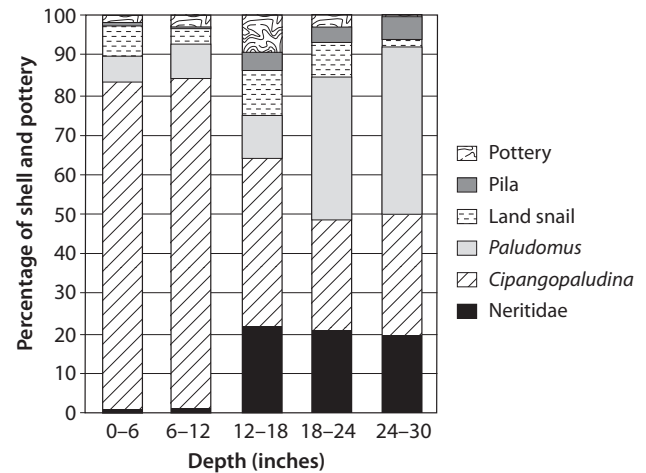


Figure 5.29. Frequency (Minimum Number of Individuals) by depth of major molluscan taxa in trench US/17a in Lobang Hangu. The category Neritidae includes *Neritodryas dubia*, *N. subsulcata* and *Neritina petiti*, which were conflated by Tom Harrison when the original on-site counts were carried out. (Data compiled by Katherine Szabó.)

US/17a, for example, the freshwater species *Paludomus everetti* and *Ctenodesma borneensis*, characteristic of the early Hell deposits on the West Mouth, are dominant from 30 inches downwards to the virtual exclusion of all other taxa except terrestrial snails (Fig. 5.29). Brackish-water taxa in the Neritidae and the bivalve family Corbiculidae are restricted to depths above 30 inches, and concentrated in a band from 6 to 18 inches. These taxa, both by stratigraphic position and radiocarbon dating of deposits, are synchronous with the Early to Mid-Holocene marine transgression (see Chapter 6). Hence the shell assemblages of interest in this chapter are freshwater assemblages with little or no saline tolerance, underlying distinct brackish-water assemblages.

Land snails are numerous in Pleistocene levels. Their rarity within deposits further into the West Mouth (e.g. Area D, discussed in Chapter 6), as well as their very varied sizes (from micro-species to species several centimetres in diameter), suggest that they are self-introduced. Accumulations of numbers of land snails signal the longevity of fairly stable surfaces, and in some instances clearly demarcate stratigraphic boundaries.

Area A

In addition to Late Pleistocene shell recovered from the W-series and Y/E-series trenches in this part of the West Mouth, broadly-synchronous deposits were also pinpointed in the lower spits of many of the E/A,

E/B, E/G and E/W series trenches, with trace assemblages also recognized in the E/F and E/SP series. In all instances, but to varying degrees, the deposition of shell is much sparser in Pleistocene deposits than in the Holocene levels that cap them. Whilst this is partly a taphonomic issue (Tom Harrisson noted the fragile state of many shells at depth), preservation is often good, pointing to different intensities in deposition.

Traces of Late Pleistocene shell midden are ephemeral around the fringes of the major excavated deposits, such as the trenches within the E/F series (E/F1 and E/F6) and the E/SP series (E/SP2), whereas denser accumulations are seen in both the E/A-series (E/A1–E/A3) and E/G-series, where hundreds of *Paludomus everetti*, supplemented by the freshwater mussel *Ctenodesma borneensis*, were recovered. In E/A1, E/A2 and E/A3, brackish-water and mangrove-associated molluscan remains are found at 36 inches and above, whereas between 36 inches and 72 inches *Paludomus everetti* is overwhelmingly dominant (their numbers being respectively 576, 527 and 726 individuals), accompanied consistently only by the mussel *Ctenodesma borneensis* and terrestrial snails. E/A3 has just eight shells of other non-terrestrial species below 48 inches. The E/B series of trenches has a very similar stratigraphic sequence, with 1491 *P. everetti* shells recovered between 24 and 96 inches in E/B1 compared with ten individuals of other species (excepting land snails, freshwater mussel and fossil oyster valves) recovered below 36 inches. E/B2 contains 1324 *P. everetti* shells below 24 inches, with even lower representation of other taxa.

In contrast, the zones of Area A clearly associated with Late and Terminal Pleistocene occupation, such as the W and Y/E series, have restricted numbers of freshwater shells. W2 has only 39 *P. everetti* in clear Pleistocene stratigraphic contexts (36–48 inches), and W4 has just fifteen *P. everetti* and two *C. borneensis* in Pleistocene context at 36–60 inches. Pleistocene shell totals are also low in the well-dated Y/E3 trench; high land-snail totals (352 at 48–54 inches, 257 at 54–60 inches) suggest a rather slow rate of deposition.

Area B

The on-site shell records for the E/D series in Area B are uncharacteristically patchy, with comments like ‘scattered river shells’ representing one of the better (though still unhelpful) descriptions. The E/D series notebooks make it clear that Tom Harrisson himself was the driving force in the rigorous quantification of molluscs, as the only serviceable information is in his hand — presumably added to the notebooks while he was checking the progress of excavations by other team members in this area. His relatively

rare interjections suggest that shell totals in the E/D series were uniformly low, with at least E/D1 being dominated by *P. everetti* from a depth of 24–48 inches. The records from the T/D series are much better, with identifications and quantitative information presented in an unpublished report (T. Harrisson 1959d). The molluscan biostratigraphy replicates that seen in Area A, with a brackish-water Early/Mid-Holocene shell fauna in the upper spits of T/D1–T/D3 (12–24 inches; no results are reported for 0–12 inches), and freshwater shell species below these to a depth of 60 inches. Again, the freshwater gastropod *Paludomus everetti* dominates categorically, with 317 individuals being recorded between 24 and 60 inches, accompanied by just four *Ctenodesma borneensis* valves at depth. As Tom Harrisson (1959d) recognized, the densities of bone and shell are not entirely congruent: bones dominate over shell at 12–24 inches (respectively 20 per cent and 17 per cent of the assemblage) and 48–60 inches (respectively 24 per cent and 9 per cent), shell and bone are roughly equal at 24”–36” (26 per cent shell and 25 per cent bone), and shell dominate at 36–48 inches (48 per cent shell, 31 per cent bone). These differential patterns of bone and shell frequency could simply reflect depositional patterns within the cave, or changes in the structure of the subsistence economy.

Lobang Hangus

A total of 37,455 molluscs (MNI) was recovered from the 1959 and 1965 excavations at Lobang Hangus, with shells equally well represented throughout the deposit (unlike the vertebrate fauna), from the Pleistocene to the Metal Age levels. As in the West Mouth, the sequence begins with a freshwater shell assemblage in the Late Pleistocene, with *Paludomus everetti* the dominant species and lower numbers of the bivalve *Ctenodesma borneensis* and the scavenging gastropod *Clea nigricans*. This was replaced by a brackish-water assemblage in the Early/Mid-Holocene, and by dense concentrations of *Cipangopaludina* cf. *chinensis* in the upper Metal Age spits (see Chapter 8).

The spatial and depth distributions of the Pleistocene shell accumulations follow broadly the patterns noted for animal bone, but as with Area B, diverge slightly. Pleistocene shell is located at a shallower depth towards the front of the cave, concentrated at a depth of 18–24 inches in US/10 and US/15. The extant shell sample for US/14 is incomplete. Further back into the cave (e.g. US/18, US/22 and US/26), the Pleistocene shell layer is present from 36 inches to depths ranging from 42 inches in US/18 and US/26 to 60 inches in US/22 and US/21b. Pleistocene shell totals in these inner trenches are uniformly rather low: trench US/17a is typical (Fig. 5.29). Shell totals

for trenches bordering the eastern edge of excavations (US/19, US/23 and US/27) are much higher, but both the distributions of pottery and various shell species suggest that there are major issues with downward movement and disturbance in these trenches.

The re-analysis of the 1959 material gave, for the first time, a chance to investigate the composition of the land-snail assemblage. In all of the original on-site notations, land snails are grouped together as 'shell number 12', providing no insights beyond gross abundance. Land-snail abundances vary from trench to trench, with the highest totals closest to the entrance. In all areas of the site, snails of the family Cyclophoridae dominate, ranging from the large (c. 3 cm diameter) *Cyclophorus perdix borneensis* and *C. niahensis*, to medium-sized (c. 1.5 cm diameter) species including *Pterocyclos niahensis* and *Opisthoporous birostris*, to the small (<1 cm) *Leptopoma* spp. Ground-dwelling and moisture-loving, cyclophorid snails are not found in open or significantly disturbed environments, and are abundant around the Subis today. Their presence, together with numbers of the arboreal *Amphidromus pictus* (Camaenidae) and forest-dwelling *Macrochlamys* spp. (Ariophantidae) in Pleistocene levels, indicates forest cover in the immediate environs of the cave.

Gan Kira

The bulk of shell recovered from Gan Kira relates to Metal Age and Early/Mid-Holocene occupation, but there are hints of ephemeral Pleistocene occupation throughout much of the site. Pleistocene shell deposits were isolated where samples from the lowermost spits of the various trenches were large enough to characterise the assemblage in ecological terms: Y/A9 and Y/A10 from 18 inches to base, Y/B1 to Y/B5 from either 18 or 24 inches down depending on the trench, Y/E3 from 30–36 inches, and Y/G4 from 18–30 inches. Whilst not all contiguous, these trenches are all located in the central part of the site, cradled within the main cluster of large rocks. The extent of Pleistocene shell deposits at Gan Kira may well be greater in extent than these trenches, but extensive time averaging coupled with low levels of deposition in the early phases of site use means that any such material cannot now be distinguished from Early/Mid-Holocene material above. As with all other studied deposits of this time period, *Paludomus everetti* dominates the Pleistocene shell assemblage, as in the West Mouth and Lobang Hangus, although totals are generally much lower than those in Lobang Hangus. Land snails are also far less abundant at Gan Kira, which is perhaps unsurprising given the steep nature of the drop-off to the forest floor at the cave mouth.

Gathering plants [HB, LK, VP]

The archaeobotanical remains from the period discussed in this chapter present an exceptionally rich picture of the foraging activities of the people using the Niah Caves in the Late Pleistocene. Several techniques were applied to recover evidence of plant use at the site including recovery of starches from cave sediments and tool residues, phytolith analysis of sediments, and bulk flotation of environmental samples. None of these techniques recovered large quantities of material, and sampling was largely directed by the blocks of sediment that were available for excavation and sub-sampling. As a consequence of this our results produce an incomplete temporal sequence and cannot inform us of trends in resource use over the significant climatic events encompassed by this chapter. However, they do provide important insights into the range of plants exploited in this period, indicating the continuation of trends in plant exploitation observed in the period c. 50,000–35,000 BP (Table 5.13). The microscopic analysis of starch grains (by HB) and phytoliths (by LK) in sediments and the study of macroscopic remains of plants from flotation (by VP) show that people in the Late Pleistocene were exploiting a variety of roots and tubers, fruits and nuts. The starch record includes granules from tubers, roots and palm pith (sago). The phytoliths recovered include a diverse range of economic species such as plants useful for fibres, for edible fruits and bamboo; no palms were found, but the sediment samples analysed for phytoliths also contain starch grains with sizes comparable to starch storage organs such as roots or fruits. The macro-plant remains include seeds, nut exocarps, fruit skins, root tubers, charred tubers, and charred parenchyma tissues from fruits and tubers, and starch granules from tubers, roots, and palm pith (sago). The phytolith data also recovered a diverse range of economic species. No palms were present. Phytolith samples also contained starch grains, with grain sizes comparable to starch storage organs such as roots or fruits.

The main tuberous species recovered included traces of the family of true yams, Dioscoreaceae, and rhizomes of the family Araceae, also referred to as aroids. Often these plants are mixed together in discussions of forest flora as 'roots' or 'tubers', but they maintain completely different growth habits and produce different types of subterranean starchy organs, so should properly be discussed separately. Evidence for exploitation of yams in these levels comes from a few fragments of charred tissue of the highly poisonous yam, cf. *Dioscorea hispida*, and an unidentifiable root fragment. These pieces were recovered from Section

Table 5.13. Plants recovered from the Late Pleistocene deposits in the West Mouth of Niah Great Cave (wi = wild; f = feral; d = domesticated).

Family	Species	Common name	Status	Condition
Aracaceae (palms)	<i>Caryota mitis/ Eugeissona utilis</i>	Clustering fishtail palm/Hill sago palm	wi	starch granules
	<i>Calamus</i> spp.	Rattan/rotan	wi	charred nut fragments
cf. Apiaceae alt Umbelliferae			wi	seeds
Araceae (aroids)	<i>Alocasia longiloba</i>		wi	starch granules
	cf. <i>Colocasia elim esculenta</i>	Taro; 'keladi'	wi, d	charred parenchyma
	<i>Cyrtosperma merkusii</i>	Swamp taro	wi/f	starch granules
	Unknown rhizomes			charred parenchyma
Cyperaceae (sedges)				charred seeds
Dioscoreaceae	<i>Dioscorea</i> sp.		d	starch granules
	cf. <i>Dioscorea hispida</i>		wi	charred parenchyma
	Unknown tubers			charred tubers & charred parenchyma
Elaeocarpaceae	<i>Elaeocarpus</i> sp. (<i>stipularis</i>)	'Kusap'	wi	charred nut fragments
cf. Fabaceae				charred seeds
Flacourtiaceae	<i>Pangium edule</i>		wi	charred nut fragments
cf. Moraceae	<i>Artocarpus</i> spp.		wi	charred fruit fragments
cf. Urticaceae	<i>Bohemeria</i> cf. <i>platanifolia</i>		wi	charred seeds
Unclassified fragments	Nut exocarp fragments			charred nut fragments
	Fruit fragments			charred fruit fragments
	Parenchyma			charred parenchyma

8.1 in Area B (contexts 1047~2078) dated to 21,360±80 bp or 25,099–25,916 cal. BP (OxA-V-2077-8). The presence of *D. hispida* was completely unexpected, owing to the very toxic nature of this plant, but is consistent with the presence of nut exocarp fragments from *Pangium edule* in earlier deposits, and from the upper layers in the Hell Trench, indicating that Late Pleistocene foragers at Niah knew how to remove toxins from several types of rainforest toxic plants.

In all samples there was more evidence of the use of aroid rhizomes than yams, a pattern that appears consistent with residues from stone tools from Pleistocene and Holocene contexts in several Melanesian sites (Barton & White 1993; Denham *et al.* 2003; Loy *et al.* 1992). A fragment of charred aroid tissue identified as cf. *Colocasia esculenta*, taro, was recovered from a layer (context 1020) at the base of Area A Block B, dated to 19,650±90 bp or 23,086–23,859 cal. BP (OxA-11550), which is the earliest direct evidence we have for the use of this extremely important plant in the tropics (Fig. 5.30). Starch granules from *Alocasia longiloba* were also recovered in this layer. Immediately overlying a layer in Area A Block A (context 1025) dated to 27,960±200 bp or 31,528–32,822 cal. BP (OxA-11304) were starch granules of the aroids cf. *Cyrtosperma merkusii*, swamp taro and *Alocasia longiloba*, an aroid common in the surrounding forest. A single fragment of aroid rhizome tissue was also recovered below this layer at the base of Block A (context 1086).

Most nut and fruit remains were recovered from a single but very productive sample in the Area B Sec-

tion 2.1 (context 1047~2078) dated to 21,360±90 bp or 25,099–25,916 cal. BP (OxA-V-2077-8). This produced multiple fragments of fruit skins including several with thick fleshy exocarps similar to the fruits of *Artocarpus* spp. This genus includes the economically important jackfruits (including *Artocarpus heterophyllus*), of which many varieties are exploited, and breadfruit (*Artocarpus altilis*), as well as some other lesser known edible varieties. A number of nut fragments were also recovered here, some of which appear similar to the genus *Canarium*, a widely distributed tree that appears in several other tropical sites and is a strong candidate for early domestication (Yen 1995). The status of the genus *Artocarpus* as an early domesticate is little discussed, but is an important candidate for early forms of plant management. During the 1977 excavations of the Hell Trench conducted by Zuraina Majid, a number of charred and un-charred nut fragments were recovered from the upper levels including several fragments of *Pangium edule* (Zuraina Majid 1982). Other fragments less securely identified include charred remains of a legume (cf. Fabaceae), and seeds from Urticaceae and Umbrelliferae, the economic importance of which is unknown.

The presence of toxic plants in these deposits, including *Pangium edule*, *Dioscorea hispida*, and the non-toxic but 'itchy' *Colocasia esculenta* and *Alocasia longiloba*, raises the interesting question of how people removed these poisonous or irritating compounds. The toxin within *Dioscorea hispida* is an alkaloid, dioscorine, that can cause paralysis of the nervous

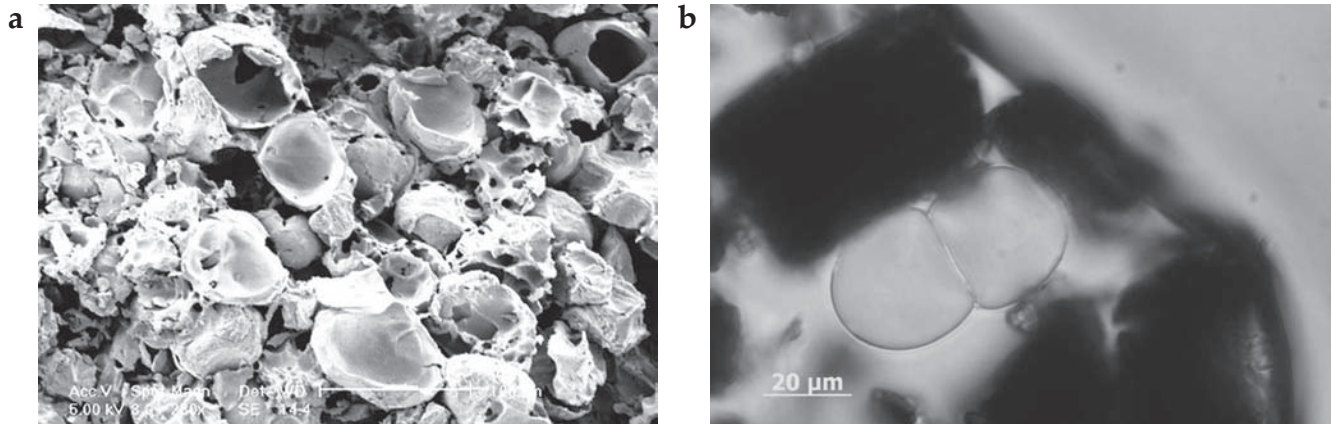


Figure 5.30. Plant remains from the Late Pleistocene occupation in the West Mouth: (a) parenchyma tissue of *Colocasia elim. esculenta* (aroid) and (b) starch granules of another aroid, *Alocasia longiloba*. (Parenchyma photograph: Victor Paz; starch photograph: Huw Barton.)

system, and hydrocyanic acid is the toxic component of *Pangium edule*; both chemicals can cause death if not properly treated. The compounds within wild varieties of taro (*Colocasia esculenta*) and other aroids include ‘proteases’ and needle crystals known as ‘raphides’ that irritate the skin. Such toxins and other compounds are normally destroyed or alleviated by soaking and leaching, and through the application of heat either by boiling or dry roasting, or various combinations of each. While these activities certainly add to the cost of processing these plants, in most cases they do not outweigh the effort of collection and processing. For example, the yam *Dioscorea hispida* was until the recent past an important food for several groups of nomads in peninsular Malaysia and in the Philippines (Burkill 1966 NOT IN REFS; Eder 1978 NOT IN REFS; Endicott 1984 NOT IN REFS; Kuchikura 1993). Amongst some groups this particular yam comprised 30–75 per cent of the total calories of wild yams collected and processed (Eder 1978 NOT IN REFS, 61; Kuchikura 1993, 92). While poisonous, this species is shallow rooting, producing large globular tubers located near the surface, making collection far easier than for most other species of yam, which are deep rooting. Similarly, *Pangium edule* is a tall tree that irregularly produces prodigious quantities of fruits, and it remains a regular target of many forest peoples who exploit the sudden glut of production (Kuchikura 1993). Detoxification of the nut involves similar processes to that of the yams such as prolonged soaking followed by extensive cooking.

There are several ‘recipes’ associated with the detoxification of plants across the region, including one associated with *Pangium edule* that consists of allowing the flesh of the fruit to decay, then placing the nuts into shallow pits filled with ashes that are left for

up to 40 days, after which time the nuts are exhumed and cooked before eating. The pits containing ash and nut fragments in Section 2.1 in the West Mouth (Figs. 5.11 & 5.15) could conceivably be associated with such activities. As discussed earlier in the chapter, these pits seem likely to be a fraction of the pits dug in this part of the West Mouth by Late Pleistocene visitors to the caves.

The phytoliths from the sediment monolith 3/2 1M, and two phytolith samples taken from the pits in Section 2.1, all show a rather different selection of plant species than in the earlier (pre-c. 35,000 BP) levels. There is a range of silicified tissue fragments from a diverse assemblage of fibres or wood in addition to plant foods. The differences might be due to sampling biases, but the environmental diversity represented by the data, together with the range of potential economic species present, suggest a very wide range of uses of economic plants. One of the samples from Section 2.1 also had a significant component of micro-charcoal, perhaps hearth debris.

Forest disturbance [HB, CH, LK]

The pollen record from the West Mouth includes similar evidence for the Late Pleistocene as for the initial phase of human occupation discussed in the previous chapter, of human activity coinciding with increases in the quantity of *Justicia* pollen, interpreted by CH as evidence for the deliberate burning or other disturbance of forest outside the cave (Table 3.2). The phytolith evidence studied by LK is also suggestive of small-scale disturbance of local arboreal vegetation outside the cave at this time. The (admittedly rare) occurrences of panicoid grass forms and palm phytoliths in the 3/2 1M sediment block are all burnt,

and whilst they might represent fire-starting material, they could also derive from wind-deposited ash from outside the cave, especially given that the assemblage includes several phytolith forms suggestive of more herbaceous taxa than in the samples from below the mudflow. Burnt phytoliths and micro-charcoal are certainly far more frequent in these assemblages than in those associated with the initial occupation of the cave discussed in the previous chapter.

Humans are implicated in the deliberate burning of vegetation in the rainforest uplands and lowlands of Papua New Guinea from at least 40,000 BP (Denham & Barton 2006; Fairbairn *et al.* 2006; Haberle *et al.* 2001). In Borneo, apart from the pollen and phytolith evidence at Niah, there are indicators of human-induced firing dating to slightly before 30,000 BP in the lowland Lake Sentarum core in West Kalimantan (Anshari *et al.* 2004) as well as possibly as early as 60,000 BP according to Kershaw *et al.* (2007). The signature of burning at all of these locations is consistent but also intermittent and patchy, reflecting a haphazard firing regime. More sustained burning regimes appear to develop especially after the LGM on the evidence of high levels of burning in sediment cores in Indonesia and Papua New Guinea (Haberle *et al.* 2001; van der Kaars *et al.* 2001 **NOT IN REFS**; Taylor *et al.* 2001 **NOT IN REFS**), although it is also true that the landscape at this time, with large areas of savannah and grassland and more open forest (Cannon *et al.* 2009; Gathorne-Hardy *et al.* 2002; Heaney 1991) was more susceptible to burning.

Foraging and mobility in the Late Pleistocene

[HB, GB]

The material record from Niah discussed in this chapter reveals that people had developed highly effective ways of living in the Late Pleistocene landscape. During the distinctive episodes before and after the cooler and drier and more open landscapes that prevailed during the LGM, when dense lowland rainforest, sometimes with swamp forest, dominated the Niah landscape, people exploited the lowland Dipterocarp rainforest, freshwater rivers, lagoons and streams, and when accessible, mangrove swamp. As hunters during these various rainforest-rich times, they targeted wild pig especially but they were also adept at acquiring arboreal primates, using a combination of spears, traps and after the LGM, some kind of ballistic weaponry, probably the bow and arrow. They harvested freshwater snails such as the gastropod *Paludromus everetti* and the mussel *Ctenodesma borneensis*. They collected a wide range of fruits, nuts and tubers, and had developed techniques to detoxify them when necessary. Especially after the LGM, they may have

regularly practised burning forest edges to enhance plant and animal productivity. The evidence discussed in this and the previous chapter clearly demonstrates a long history of people–plant interactions, including with several important starch species cultivated today including taro, swamp taro, sago and yams.

There were significant changes to the nature of occupation in the West Mouth between the end of the LGM and the Pleistocene/Holocene boundary: a large ash-rich midden formed after *c.* 17,000 BP, and there was a general increase in wood ash. The appearance of new implement types associated with food acquisition and processing, the intensification of refuse disposal and burning in the cave entrances (in the West Mouth in particular), the variation in the hunting regimes practised at the West Mouth and Lobang Hangu (with the emphasis on the targeted exploitation of arboreal fauna at the latter) and the evidence for small-scale forest burning, in combination suggests that the caves were used for more extended and intensive occupations after the LGM than hitherto, associated with the intensified use of forest foods in the surrounding landscape. How ‘extended’ were individual visits to the cave entrances at any one time is difficult if not impossible to gauge: snares and traps would have needed checking (and repairing if necessary) every few days; detoxifying plant foods in pits would have taken several weeks. Although there was a mosaic of different vegetation types around the Niah Caves in the Late Pleistocene, the differences in the characteristics of the West Mouth and Lobang Hangu occupations, and of the food refuse discarded there, imply that people used different camping locations for different purposes and probably at different times within the foraging year.

The composite radiocarbon record from Late Pleistocene occupation sites in Vietnam, Thailand, Malaysia and Indonesia suggests that there was a significant contraction in settlement in the increasingly arid millennia before and during the LGM (*c.* 28,000–20,000 BP), followed by a sudden expansion after 20,000 BP (O’Connor & Bulbeck in press). The trough in the regional ¹⁴C profile is *prima facie* evidence that many locations were abandoned during the LGM. Sites in prime locations, however, in particular with access to a good water supply and to a wide range of habitats, continued to be foci of human occupation. In the highlands of central Thailand, for example, the large riverside rock-shelter of Tham Lod was used from *c.* 34,000 BP to the end of the Pleistocene as a base for foraging for a wide array of mammal species and riverine resources (Marwick 2008). It is possible that the landscape around the Niah Caves was a similar refugium: of the more than 35 ¹⁴C dates from the Niah

Caves falling into the period of use discussed in this chapter, six are earlier than 30,000 BP, over a dozen fall into the millennia of the LGM, and over twenty are located in the period between the end of the LGM and the Pleistocene/Holocene transition. There appears to have been sparse use of the caves in the millennia following the guano mudflow, then consistent use during the LGM when cooler and drier climates and a more open though still varied landscape prevailed, followed by significant intensification in human occupation after the LGM.



Figure 5.16. Section walls lying west of Section 2.1 (what may be squares E/A1 and E/A2 or possibly squares E/D3 and E/D2), without evidence of ashy layers. (Harrison Excavation Archive photograph na 1507, reproduced with permission of Sarawak Museum.)

SHOULD THIS BE FIGURE 5.16 INSTEAD OF WHAT I'VE USED ON p. 191? - DORA - 1957 na 164